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The Effect of Burnout Syndrome on Social Media Addiction: The Case of Healthcare Workers

Enderhan KARAKOÇ¹, Nesrin ÖĞÜT², Avşar ASLAN³

Abstract

Social media is one of the communication tools whose using and prevalence has increased rapidly in recent years. In particular, the rapid development of information technology and the proliferation of smartphones have created the perfect environment for social media addiction, which affects all members of society, including health professionals. Available evidence suggests that the direct and indirect effects of social media addiction on human health may include, among other things, burnout. This study was conducted to reveal the impact of burnout syndrome on social media addiction. The study utilized purposive sampling technique; face-to-face survey technique was applied for data collection. The findings of the study show that the healthcare workers participating in the study have a moderate level of burnout syndrome and social media addiction. Social media addiction differs according to the gender of the participants. Again, it was found that there was no significant difference in burnout level according to gender, but there was a significant difference according to marital status. A significant difference was also found between the level of social media addiction and educational status. Another important result of the study is that there is a positive relationship and effect between social media addiction and burnout level.

Keywords: *Addiction, Social Media, Burnout Syndrome, Social Media Addiction, Health Professionals.*



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1. INTRODUCTION

The new digital age has brought extraordinary technological advances that have changed how many people access and use information. These rapid technological advances have made social networks or the internet indispensable in people's daily lives (Cabral, 2011, Sarıçam & Adam Karduz, 2018). In the digital world we are in, the need to access information and use it effectively is a need that people cannot give up. The quickest and easiest way to fulfil this need, that is, to access information, is undoubtedly the internet. The internet is not only a system that connects many computers worldwide, but also a medium that allows many groups and people to communicate and interact with each other. In this manner, social media is rapidly becoming the most important communication tool and one of the most popular applications of the Internet. In other words, Internet use rate and the frequency of using social media are increasing. Social media platforms enable communication and provide almost all the needs of individuals in many areas such as entertainment, obtaining information and using search engines. Thus, it is evident that individuals who meet all their needs on social media will not need another tool (Tektaş, 2014).

With the functional inclusion of the Internet in our lives and communication environment since the 1990s, it has begun to have an increasingly deepening impact on humanity's thinking, perception and vital routines, as is the case with every new communication technology. In the case of the Internet, the harmony of this relationship between communication and technology has intensified, accelerated and become more complex with the changes within the Internet itself. In this respect, social media, which comes from within the internet itself, has taken users far beyond just following the content produced from a point or institutions and brought them to the position of creating content, and over time, this user-generated content creation has reached a more complex and diversified situation. In fact, it can be stated that individuals have become content producers at a mass level when the target audience reached by their accounts on social networking sites is taken into account. Social media, which has been so integrated into the life of humanity, has become an integral part of people's lives today, almost like an organ. This situation has become an indispensable communication technology and environment not only in the individual context but also at the level of institutions, organizations and even states (Balçı et al., 2019).

In the international literature; excessive use of social media and usage practices of these platforms (Balçı & Gölcü, 2013; Savcı & Aysan, 2017; Griffiths et al., 2012) give way to self-esteem (Balçı et al., 2020b; Buran Köse and Doğan, 2017; Eroğlu and Bayraktar, 2017; De Cock et al., 2014; Hawi and Samaha, 2016; Kircaburun, 2016), loneliness (Baltacı, 2019; Yavich, Davidovitch Frenkel, 2019; Tok and Arslan Aldemir, 2023), and depression (Aydın et al., 2021; Balçı and Baloğlu, 2018; Haand and Shuwang, 2020).

Within these variables, this study examines the impact of burnout syndrome on social media addiction in order to review and contribute to the existing literature. Burnout is a state of physical,

emotional and mental exhaustion towards the profession and life that develops with chronic physical fatigue, loss of hope and negative thoughts (Günher Arıca et al., 2011). In other words, burnout, which emerges as a result of chronic job stress, is a state of exhaustion that occurs when a person doubts the value and competence of his/her job (Ahole et al., 2006). Social networking platforms, one of the innovations that have entered our lives thanks to digitalization, provide fast and easy communication, and cause many previously unnoticed problems. There are many opinions and remarkable studies that the use of information technologies leads to many negativities such as addiction and technology-family conflict and excessive workload. It is observed that the intensive use of social networks causes people to be exposed to excessive information, which increases their stress levels and causes both physical fatigue and emotional exhaustion. It can be stated that burnout has recently begun to be seen as an important problem and there has been a significant increase in studies on burnout. There are opinions that one of the reasons why burnout is considered as a widespread problem is the new life and working styles brought by modern life. For example, it is seen that the concepts of burnout and fatigue, such as loneliness, stress and depression, have started to be addressed in terms of technology and internet use. In this respect, it is also seen that intensive discussions have stated that the use of social media platforms leads to burnout and fatigue (Omay and Omay, 2022). Considering the importance of burnout in this context and its presumed relationship with social media addiction and the lack of research on the subject in Turkey, it seems that more studies on burnout syndrome and social media addiction are needed. Therefore, in the light of previous literature, this research attempted to confirm previous findings regarding both burnout syndrome and social media addiction. We tried to provide original data about the burnout syndrome variable and to what extent it affects social media addiction.

2. LITERATURE REVIEW

The rapid development of information technology and widespread use of the Internet in recent years has created a perfect environment for social media addiction. This condition affects the whole society, including healthcare professionals. Current evidence suggests that the direct and indirect effects of social media addiction on human health may include burnout, among other factors (Badri, 2023). Burnout syndrome, defined as a disease of the modern age, was seen as an important concept in the mid-1970s and has been widely researched in many fields such as occupational health and applied psychology (Ülbeği and İplik, 2017). Burnout syndrome, which occurs due to the emotional wear and tear process, is affected by various factors. Especially the excessive and uncontrolled use of social media is a very important factor and is sometimes neglected. People inherently need to belong and form relationships, and interpersonal communication is an important key to fulfilling this need. In other words, social media addiction is the irrational and excessive use of social media to the extent that it negatively affects many areas of life. Many factors affect social media addiction. The most important of these factors is the widespread use of smartphones and the cheap and easy access to the internet (Badri, 2023).

2.1. Social Media Addiction

The emergence of many social networks in recent years has reshaped people's communication, interaction, cooperation and even the learning process (Çam & İşbulan, 2012). While the virtual world created by social networks is gradually gaining a position of reality in terms of politics, economics, relations, information, etc.; developments such as the diversification of social network platforms, the introduction of new opportunities, the integration of its use into different business lines thanks to different technologies, especially in the individual context, function as a factor that increases the use of social media and strengthens its place among the indispensable applications of people's lives. In other words, in addition to establishing different interactions in our personal lives thanks to social networks, these new web tools have also provided significant transformations in our professional lives. At the same time, it is also seen that social networks have a very wide range of effects, from how work is done to how employers hire their employees. In fact, social media is a high-risk phenomenon that, on the one hand, offers us unlimited opportunities and, on the other, raises concerns for those who know how it can be misused and abused. When hundreds of millions of people use them, expecting only positive outcomes it is not always possible. The world of social networking is a medium of interaction and communication, with its advantages and disadvantages. (Balçı et al., 2019, Popova, 2011, Tektaş, 2014).

Relatedly, as social media platforms continue to proliferate, the disadvantages of social media, an increasingly important issue, can easily be overlooked due to its seemingly endless benefits. On the one hand, social media facilitates the loss of ownership and control over content due to the increasing overlap of private, public and institutional spheres. It is important to strike a careful balance between professionalism and freedom of expression to ensure that the posts produced on these platforms do not constitute a crime or damage the reputation of others. In this sense, social media content quality varies widely, ranging from real to fake news. On the other hand, misinformation can spread around the world in a very short time and thus negatively affect people's perceptions and opinions. In addition to all these, other disadvantages include time pressure, plagiarism, misrepresentation, addiction and negative psychological consequences (Dwivedi et al., 2018). Among these disadvantages, one of the most emphasized complications in the context of social media, which is a very important problem for society and the individual, is that people use social networks to the level of addiction. Social media addiction can also be considered as a more special case of other addictions such as internet and technology addiction (Balçı et al., 2019).

In fact, when used correctly, social media has numerous positive advantages for both individuals and businesses. Social media is potentially a cause for concern because of the mass appeal of social networks on the internet, especially the ever-increasing amount of time people spend online. This is because some people engage in a variety of potentially addictive activities online. Young categorized internet addiction as computer game addiction, web surfing addiction, online gambling and shopping addiction, online pornography and relationship addiction (Kuss and Griffiths, 2011).

People use social media, which has become an increasingly popular leisure time-activity in many countries around the world, with many motivations such as playing games, socializing, spending time, interacting, and engaging in many different types of entertainment and social activities, including sending pictures. All these activities are among the main factors that trigger social media addiction (Andreassen et al., 2017, Kırık, 2013). Furthermore, given the relevance of social networks to various social functions, people may consciously or unconsciously use social media as an instrument or medium for social comparative functions such as self-evaluation or self-improvement (Vogel et al., 2014).

In addition to its numerous functions, social media, which people have been using as an important socialization tool in recent years, offers individuals the opportunity to interact and communicate more than ever. From this perspective, it is the cheap and easy access to the internet that makes social media platforms so popular. This can be seen as a justification for the increase and widespread use of the internet. However, people may encounter negative situations in their daily lives due to spending too much time on social media. Experts define some negative situations arising from this excessive use as social media addiction (Balci and Baloğlu, 2018, Shahnawaz and Rehman, 2020).

The concept of addiction is a chronic disease influenced by genetic, psychosocial and environmental factors that negatively affect a person's physical, mental and social life and/or a recurrent disorder that increases the risk of associated personal and social problems. Addictions are generally evaluated in two main categories as substance addiction and behavioral (non-substance addictions) according to their characteristics (Şahin and Günüş, 2020). Addictive behaviors are often subjectively experienced as 'loss of control' and occur despite attempts at voluntary avoidance or moderate use. These patterns of habituation are typically characterized by immediate gratification (short-term reward) and are often compounded by delayed harmful effects (long-term harms) (Griffiths, 2005). In other words, addictive behavior is referred to as impulse control disorder and is increasingly known as treatable form of addiction. In behavioral addictions, in complete contrast to substance addiction, there is often little or no need for, or easy access to, an object that helps the problematic behavior to occur. Soft or process addictions, such as overeating, technology addiction, exercise, mental obsession, sexual addiction, compulsive shopping and problem gambling, are also used for the category of behavioral addiction, which, unlike chemical addiction, are not substance-related. In these types of addictions, the behavior of compulsion to engage in a particular activity occurs many times until it causes harmful consequences for users' physical and mental health, social life or well-being (Zaremohzzabieh et al., 2014).

At this point, a review of the literature reveals that demographic characteristics have significant effects on social media addiction. In this context, Çam and İşbulan (2012) conducted a study to determine the Facebook addiction level of pre-service teachers and found that men use Facebook more than women. Andreassen, Torsheim, Brunborg, and Pallesen (2012) found that women were more addicted to Facebook than men. Some studies differ from the results obtained in these studies. One of

these studies is the study by Balçı et al. (2019) on self-esteem as a determinant of social media addiction, which shows that social media use does not differ according to gender.

In summary, based on the fact that social media platforms, which have become dominant in interaction and mass communication, are an important communication tool used for a wide range of different purposes such as professional, entertainment or information (Balçı et al., 2019), social media addiction, which shows the pathological and problematic dimension of social networks, stands out as a sensitive problem that needs to be investigated in different aspects and through different variables and these researches should be repeated in the context of different categories

2.2. Burnout Syndrome

Burnout syndrome, which is characterized as an important disease of the modern age, which we examined as another variable of our study, was accepted as an important concept in the 1970s and has been one of the widely researched topics in the field of occupational health and clinical psychology until today. Burnout, which is a concept that is widely experienced by people both at the time of its emergence and today, has been the subject of study by many researchers to answer questions such as how it occurs and the reasons for its emergence. At the same time, practitioners have aimed to reach methods of coping, preventing or combating burnout. For this reason, burnout syndrome has been recognized by researchers and practitioners as a social problem that needs attention and prevention since its emergence, and has been an important scientific subject about which numerous studies, congresses and symposiums have been organized (Schaufeli et al., 2008, Ülbeği and İplik, 2017).

Burnout is a reaction to stressors characterized by feelings of fatigue and exhaustion, cynicism (individualism) and a decrease in professional competence. Freudenberger, who first used the concept of burnout, which is essentially expressed as the lack of a combination of energy and emotional resources, defined burnout as a state of depletion of one's energy and power resources as a result of failure and wear and tear due to excessive expectations (Freudenberger, 1974, cited in Ülbeği et al., 2017, Zivnuska et al., 2019). The most well-known and accepted definition of burnout after Freudenberger is the definition made by Maslach and Jackson. According to Maslach and Jackson (1981), burnout is defined as a syndrome that includes emotional exhaustion, which is frequently seen among individuals who have to communicate face-to-face with people, that is, working in the service sector, and as a result, the negative, dismissive behavior and feelings that individuals develop towards the people they interact with (Maslach and Jackson, 1981).

Burnout, which results from chronic job stress, is a state of exhaustion that occurs when a person doubts the value and competence of his/her job (Ahole et al., 2006). When an individual experiences burnout, it has negative consequences both for him/herself and for the organization he/she works for. Maslach and Jackson, who are accepted as a reference point in studies related to the concept of burnout,

examined burnout in three dimensions including emotional exhaustion, depersonalization and the decrease in individual success (Beyhan et al., 2013, Günher Arıca et al., 2011).

Emotional exhaustion, which shows the individual stress dimension of burnout, refers to depleting a person's energy and emotional resources. Following emotional exhaustion, depersonalization develops. Depersonalization is the interpersonal dimension of burnout. It is when employees treat the people they serve as objects. In other words, it indicates loss of reaction to work, negative and harsh attitudes towards service recipients. People who experience this may need help, refuse to be kind, and even discredit or belittle patients. On the other hand, low personal accomplishment refers to the individual's poor job performance, which manifests as a tendency towards a negative self-concept. In short, the third dimension of burnout syndrome, self-evaluation, involves a decline in personal achievement and feelings of inadequacy, inefficiency and failure in one's work (Budak and Sürgevil, 2005, Günher Arıca et al., 2011).

As a result, social media addiction is becoming increasingly widespread in today's world, where social media has increased its influence and power so much in every age group in all societies. In this respect, research to be conducted with different variables on the subject emerges as an important reference point in solving the addiction problem. On the other hand, increasing work stress and burden paves the way for individuals to experience energy and emotional decrease. This leads to burnout syndrome in individuals. The burnout syndrome will negatively affect both the individual and the organization.

3. METHODOLOGY

This study, which used a quantitative research, scrutinized the effect of burnout syndrome on social media addiction was. For this purpose, the study was conducted based on the relational survey model. The relational survey model is a research model which aims to determine the existence or degree of change between two or more variables (Karasar, 2023).

3.1. Research Model and Hypothesis

The main purpose of this study is to reveal the effect of burnout syndrome on social media addiction. To achieve this purpose, 6 hypotheses were established to test the model established below.

Figure 1. Research Model



H1. According to gender, social media use has a significant difference.

H2. As the educational level of the participants increases, the level of social media use decreases.

H3. According to gender, the level of burnout syndrome shows a significant difference.

H4. According to the marital status of the participants, the level of burnout syndrome shows a significant difference.

H5. Burnout syndrome has a significant positive effect on social media addiction.

3.2. Research Implementation and Sampling

The population of the study consists of healthcare professionals working in public hospitals in the center of Ankara and using social media. Developments in technology in recent years have affected healthcare professionals who provide services in the healthcare sector as in other sectors. It is seen that individuals working in the health sector are trying to use these platforms more due to their jobs and the advantages of using social media. Important developments such as the covid-19 pandemic in the current era are an important factor that increases the use of social media by healthcare professionals. In fact, the use of social media provides significant advantages to healthcare professionals in service delivery, facilitates communication with their patients and increases patient satisfaction. Due to these benefits, institutions and healthcare professionals in the health sector aim to be more involved in social media in order to stand out in the sector. At the same time, excessive use can increase the risk of addiction. On the other hand, health workers exposed to excessive stress and work intensity while performing all these services face burnout syndrome. As a result of all these developments, the aim of shedding light on an important problem such as social media addiction and burnout syndrome based on the example of Ankara makes this study important. The study utilized purposive sampling technique; face-to-face survey method was applied for data collection. 630 questionnaires were distributed to the participants and as a result of the examination, it was decided to use 556 questionnaires in the study.

3.3. Ethics Committee Approval Document

The ethics committee approval of the study was obtained from Selçuk University Ethics Committee (Approval Date: March, 2021; Approval Number: E.48831).

3.4. Data Collection

In this study, a questionnaire form consisting of 44 questions was used to reveal the effect of burnout syndrome on social media addiction of healthcare professionals. The questionnaire includes the scales described below.

Social Media Addiction Scale: The social media addiction scale designed by Shahnawaz and Rehman (2020), consisting of 21 items, is a 7-point Likert-type scale (1= Strongly disagree. 7= Strongly agree). The lowest score that can be obtained from the scale is 21 and the highest score is 147. A higher score indicates an increase in the level of social media addiction. The scale was adapted into Turkish by the researchers of this study after obtaining the necessary permissions. In this context, in terms of language validity; 3 academicians who are experts in their fields were asked to compare the English and Turkish adaptation and the prepared version of the scale form was applied to 100 healthcare

professionals to conduct preliminary tests. Thus, the final Turkish scale was prepared. The scale, which originally consisted of 21 items and six dimensions, was computed and transformed into a single variable and used as a single dimension in this study. Shahnawaz and Rehman (2020) found the Cronbach's Alpha coefficient of the scale as .96 in their study. In this study, the Cronbach's Alpha coefficient was determined as .96. In both studies, the scale was found to have acceptable validity and reliability.

Shirom-Melamed Burnout Scale: The burnout syndrome scale developed by Shirom and Melamed (2005) and adapted into Turkish by Ülbegi and İplik (2017) is a 14-item, 5-point Likert-type (1= Never, 5= Always) measurement tool. The scale designed to determine the level of burnout has a three-dimensional structure as physical, cognitive and emotional exhaustion. However, the scale was used as a single dimension in this study. In Ülbegi and İplik's (2017) study, the Cronbach's Alpha coefficient of the scale was .94: In this study, the Cronbach's Alpha coefficient for the whole scale was found to be .92. In both studies, the scale was found to have acceptable validity and reliability.

Participants' Personal Data Form: In the following section, some findings on the socio-demographic characteristics of the healthcare professionals participating in the study, frequency of social media use, duration, purposes of use, most preferred social media tool, burnout syndrome and the relationship between various variables are presented.

3.5. Data Analysis and Tests

The field research was conducted between March 1-30, 2021, using the face-to-face interview technique with the healthcare professionals participating in the study. The data obtained were processed in a computer environment through a statistical program. The Skewness and Kurtosis values obtained for the Social Media Addiction and Burnout Syndrome scales used in the study were between -3 and +3.0; in other words, it was understood that the data obtained showed a normal distribution (Çuhadar, Er, Demirel, & Demirel, 2019). Due to the results obtained, it was preferred to use parametric tests to analyze the data. In analysing the data obtained in the study, *Frequency Analysis* was used to determine the demographic characteristics and social media usage behaviors of healthcare professionals, and *Confirmatory Factor Analysis (CFA)* was used to determine the construct validity of the Social Media Addiction and Burnout Syndrome scales. *Independent Sample T-Test* was used to determine the difference in the level of burnout syndrome and social media addiction according to gender; *One-Way Analysis of Variance (ANOVA)* was used to reveal the difference in the level of social media use according to educational status; *Correlation Analysis* was used to determine the strength and direction of the relationship between social media addiction level and burnout syndrome; *Path Analysis* was used to reveal the effect of burnout syndrome level on social media addiction.

4. FINDINGS

In this section, where the findings obtained from the statistical analysis of the data obtained in the research are presented; after the demographic characteristics of the participants, first the data on social media use, then the descriptive statistics related to burnout and social media addiction are

evaluated and finally the relationship and effect between social media addiction and burnout syndrome are examined.

4.1. Demographic Characteristics of Participants

Of the participants who contributed to the research with their opinions, 55 percent were women (N= 306) and 45 percent were men (N= 250). The distribution of the health workers who answered the survey questions according to gender is convenient for comparison.

The lowest age of the healthcare professionals participating in the study is 18 years old and the highest age is 62 years old. The average age of the participants in the study is 36.

When the educational status of the participants is examined, it is concluded that 45 percent are university graduates, 29.9 percent are high school graduates, 10.4 percent are postgraduate graduates, 10.4 percent are secondary school graduates and 4.3 percent are primary school graduates.

4.2. Social Media Use

Within the scope of this study, the healthcare professionals in the sample were first asked a question to determine their daily social media usage time. According to the analysis results, the participants stated that they use social media platforms for a minimum of 10 minutes and a maximum of 720 minutes per day. The average daily social media usage time of the healthcare professionals within the scope of the study was 194 minutes and the standard deviation was 154.92.

Table 1. The difference between the participants' social media usage time according to gender

	Gender	N	\bar{X}	SD	t-value	Sig.
Social Media Usage time	Female	306	1.74	1.07	-2.043	.042
	Male	250	1.94	1.17		

According to the gender of the participants, daily social media usage time shows a significant difference ($t= -2.04, p< .05$). Descriptive statistics results show that men ($\bar{X}=1.94$) use social media for a longer time daily than women ($\bar{X}=1.74$). This finding supports *Hypothesis 1* proposed by the research.

Table 2. The difference between the duration of social media usage according to the participants' education level

	Education Status	N	\bar{X}	SD	f	Sig.
Social Media Usage time	Primary School	24	268.33	204.14	9.531	.000
	Middle School	58	232.39	143.13		
	High School	166	231.06	169.08		
	University	250	170.77	143.86		
	Postgraduate	58	124.36	95.34		

Likewise, the duration of daily social media use according to the educational level of the participants reveals a significant difference ($F= 9.53, p< .001$). Tukey Test results show that the source of the difference at the 5 percent level of significance is between primary school ($\bar{X}= 268.33$), secondary school ($\bar{X}= 232.39$) and high school graduates ($\bar{X}= 231.06$) and undergraduate ($\bar{X}= 170.77$) and postgraduate graduates ($\bar{X}= 124.36$). In other words, as the level of education increases, a decrease in the duration of social media use is felt. This finding supports *Hypothesis 2* proposed by the study.

4.3. Burnout syndrome level

In order to determine the burnout levels of healthcare workers, 14 items in the questionnaire were computed and converted into a single variable; in this way, the level of burnout syndrome of the participants was tried to be revealed. The results of the descriptive analysis show that the participants have the lowest score of 13 and the highest score of 60. The burnout level of the healthcare professionals who responded to the research questions is moderate ($\bar{X}=32.04$). In other words, the healthcare workers who participated in the research experience burnout syndrome at a moderate level.

Table 3. Descriptive Statistics of Burnout Syndrome Level

	Min.	Max.	\bar{X}	Skewness	Kurtosis
Burnout syndrome level	13.00	65.00	32.04	.245	-.293

The fact that the Skewness (.245) and Kurtosis (-.293) values obtained for the burnout syndrome scale used in the study are between -3 and +3 emphasizes that the distribution is normal.

Table 4. The difference between the burnout syndrome levels of the participants according to gender

	Gender	N	\bar{X}	SD	f	Sig.
Burnout syndrome level	Female	306	32.00	10.48	-.108	.914
	Male	250	32.10	11.49		

The gender of the participants does not create a significant difference in terms of burnout level ($t= -.108, p> .05$). Descriptive analysis results indicate that the burnout syndrome scores of women ($\bar{X} = 32.00$) and men ($\bar{X} = 32.10$) are very close to each other. While the result here is similar to the findings of Avcı and Şahin (2017), it also shows that *Hypothesis 3* is rejected.

Table 5. The difference between the burnout syndrome levels of the participants according to their marital status

	Marital Status	N	\bar{X}	SD	f	Sig.
Burnout syndrome level	Married	310	30.74	11.14	-3.17	.002
	Single	246	33.69	10.47		

According to the marital status of healthcare workers, burnout levels show a significant difference ($t = -3.17$; $p < .05$). T-test results indicate that single ($\bar{X} = 33.69$) healthcare workers experience higher burnout syndrome than married ($\bar{X} = 30.74$) healthcare workers. When the related literature is examined, it is seen that Günher Arıca et al. (2011) and Erol et al. (2007) reached different results from the results obtained here, while in Avcı and Şahin's study, similar results to our findings, that is, emotional exhaustion, depersonalization and internet addiction scores were significantly lower among married participants, and it was concluded that marriage may be a protective factor for burnout and internet addiction. The findings confirm *Hypothesis 4*.

4.4. Social Media Addiction Level

In order to determine the social media addiction levels of healthcare professionals, 21 items in the questionnaire were computed and transformed into a single variable and in this way, the social media addiction level of the participants was tried to be revealed. Descriptive statistics results indicate that the lowest social media addiction level of the participants is 21 and the highest is 147. The level of social media addiction of the health professionals participating in the study is moderate ($\bar{X} = 59.50$). In other words, it is seen that the healthcare professionals participating in the study have social media addiction below the medium level.

Table 6. Descriptive Statistics of Social Media Addiction Level

	Min.	Max.	\bar{X}	Skewness	Kurtosis
Social Media Addiction	21.00	147.00	59.50	.518	-.385

The fact that the skewness (.518) and kurtosis (-.385) values are between -3 and +3 indicates that the distribution is normal. According to the gender of the healthcare workers participating in the study, social media addiction levels differ significantly ($t = -2.69$, $p < .05$). Descriptive statistics results reveal that men ($\bar{X} = 63.10$) have a higher value than women ($\bar{X} = 56.55$) in terms of social media addiction level.

Table 7. The difference between the level of social media addiction according to education level

	Education Status	N	\bar{X}	SD	f	Sig.
Social Media Addiction Level	Primary School	24	61.08	26.05	6.57	.000
	Middle School	58	67.03	24.90		
	High School	166	66.56	29.06		
	University	250	54.58	28.88		
	Postgraduate	58	52.27	24.92		

There is a significant difference in the level of social media addiction according to the educational level of the participants ($F= 6.57, p< .01$). The results of the Tukey Test at the 5 percent level of significance indicate that the addiction levels of secondary school ($\bar{X}= 67.03$) and high school graduates ($\bar{X}= 66.56$) are higher than those of undergraduate ($\bar{X}= 24.58$) and graduate ($\bar{X}= 52.27$) graduates.

4.5. Confirmatory Factor Analyzes (CFA) of the Scales.

4.5.1. Confirmatory Factor Analysis (CFA) of Social Media Addiction Scale

Confirmatory factor analysis was performed on the 21 items constituting the scale and it was determined that 21 items were related to the 6-dimensional scale structure. Table 2 shows that the accepted values for the fit indices of the fit index calculations were met.

Figure 2. Social Media Addiction Scale Confirmatory Factor Analysis



Table 8. Confirmatory factor analysis goodness of fit results for the Social Media Addiction Scale

	Structural Model Values	Recommended Values
CMIN/DF(χ^2/df)	4.051	≤ 5
RMSEA	0.074	≤ 0.08
GFI	0.893	≥ 0.80
AGFI	0.858	≥ 0.80
CFI	0.943	≥ 0.80
SRMR	0.039	≤ 0.10

As a result of the Confirmatory Factor Analysis (CFA) of the scale, the fit index values of the structural model were CMIN= 4.05; RMSEA= 0.07; SRMR= 0.03; GFI= 0.89; CFI= 0.94 and AGFI= 0.85, which were generally acceptable (Balçı et al., 2020b) (see Table 8).

4.5.2. Burnout Scale Confirmatory Factor Analysis (CFA)

In this section of the study, the confirmatory factor analysis results and fit index values of the burnout syndrome are discussed.

Figure 3. Burnout Scale Confirmatory Factor Analysis

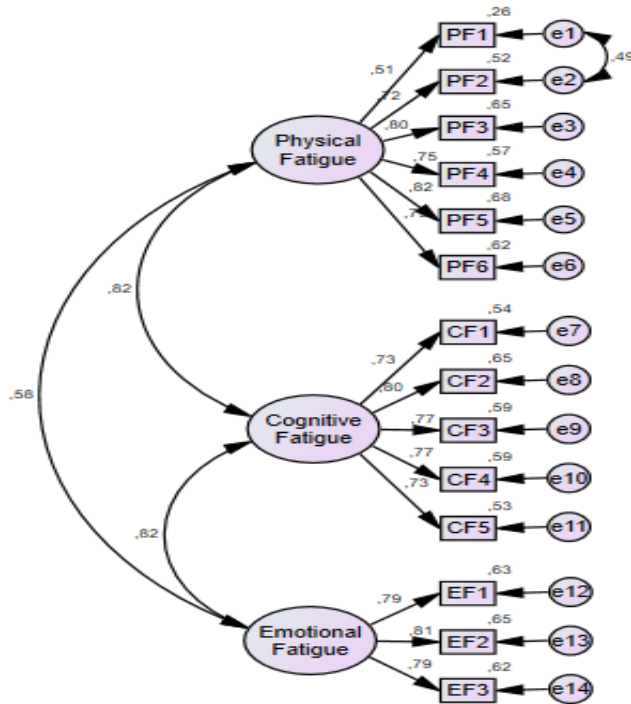


Table 9. Burnout Scale confirmatory factor analysis goodness of fit results

	Structural Model Values	Recommended Values
CMIN/DF(χ^2/df)	3.954	≤ 5
RMSEA	0.073	≤ 0.08
GFI	0.931	≥ 0.80
AGFI	0.901	≥ 0.80
CFI	0.953	≥ 0.80
SRMR	0.046	≤ 0.10

Confirmatory factor analysis (CFA) was performed on the 14 items constituting the scale and it was determined that the 14 items were related to the 3-dimensional scale structure. The table shows that the accepted values for the fit indices of the fit index calculations were met. Improvement was made between items e1-e2 in the model.

4.6. The Relationship between Social Media Addiction and Burnout Syndrome

Table 10. The Relationship between Social Media Addiction and Burnout Syndrome (Pearson r)

Social Media Addiction	Burnout Syndrome
	.579**

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

When the results of the Correlation Analysis in terms of the direction and strength of the relationship between burnout syndrome and social media addiction are analyzed, a positive and moderately significant relationship between the two variables is observed ($r = .579, p < .01$). In other words, when individuals experience an increase in the situations such as "feeling physically tired, exhausted, having trouble focusing on their thoughts and having difficulty in establishing emotional bonds with their environment", there is also an increase in social media addiction. When the international literature is reviewed (Han et al., 2020, Imani et al., 2018); it is seen that there are similar studies that support the results revealed here, and again in the study of Avcı and Şahin (2017), a significant relationship was found between burnout sub-dimensions and internet addiction.

4.7. The Effect of Burnout Syndrome on Social Media Addiction

Under this heading, the strength of the relationship between social media addiction and burnout syndrome and the effect of burnout on social media addiction were questioned. The results are presented in Table 11.

Figure 4. Effect of Burnout Scale on Social Media Addiction Scale

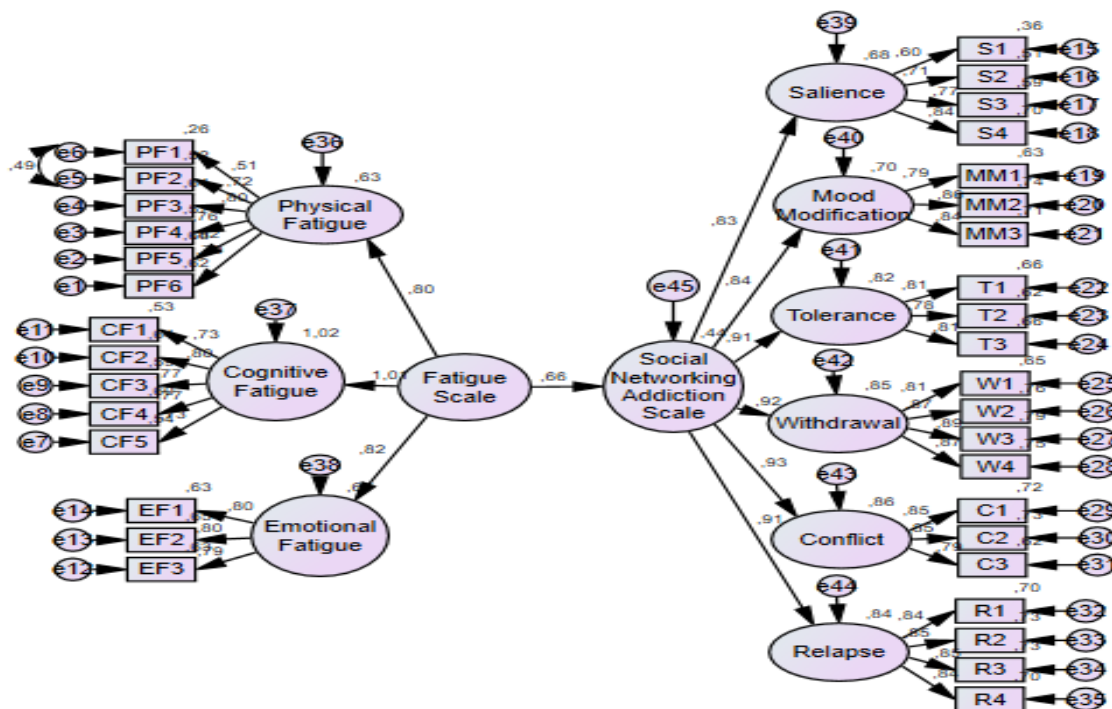


Table 11. The effect of Burnout Scale on Social Media Addiction Scale

	Estimate (β)	Standard Error	t	p	Result
Burnout → Social Media Add.	0.706	0.071	9.940	***	Acceptance

Compliance Indices:

χ^2/df : 3.144; RMSEA: 0.062; GFI: 0.834; AGFI: 0.809; CFI: 0.919; SRMR: 0.057

*p<0.05

In the model created to investigate the effect of burnout syndrome on social media addiction, it was observed that burnout syndrome had a positive and significant effect on social media addiction ($\beta=0.706$, $p=.000$). In the model where the estimated β value indicates that the direction of effect is positive, a one-unit increase in the level of burnout syndrome causes an increase of 0.706 in social media addiction. Thus, **Hypothesis 5** is confirmed. Karakose, Yirci, and Papadakis (2022) found that psychological distress after COVID-19 directly or indirectly affected the levels of burnout, social media addiction, and depression. Another study that supports the results of this study is the study conducted by Badri et al. (2023) on a sample of health students and professionals.

5. CONCLUSION

As a result of the rapid development and advances in new information technologies, especially with the widespread use of web-based social networks, interpersonal communication has changed dramatically. The ubiquity of social media platforms and easy access to the internet leads to excessive and irrational use of social media. This use of social media has led to what has been termed social media addiction, which in turn has increased public concern about social media use and addiction. With the increase in people's concerns about social media addiction, it is observed that the related literature has increased interest in the subject (Budak and Sürgevil, 2005, Cabral, 2011). Social media addiction is known to be associated with several psychological variables such as social connectedness, depression, loneliness, happiness and self-esteem (Balci & Baloglu, 2018; Savcı & Aysan, 2018; Baltacı, 2019; Balci et al., 2020b). In this study, the effect of burnout syndrome level on social media addiction level was examined in the sample of healthcare professionals.

Within the scope of the research, the social media usage habits of the participants were primarily questioned. The findings show that a significant portion of the respondents regularly spend time on social media every day and use social media tools for more than three hours (194 minutes) on average. Another finding is that there is a significant difference between men and women in terms of daily social media usage time, and men use social media more than women. On the other hand in the study of Balci et al. (2020b), it was found that there was no significant differentiation between men and women in terms use of social networking. Again, it is seen that there is a similar differentiation in daily-use of

social networking according to the age and education level of the participants, that is, according to the age and education level, the period of the daily use of social networking changes.

The results of descriptive statistics show that the level of burnout syndrome and social media addiction level of healthcare professionals is not very high. In the literature review, it is possible to find results that support the findings of the study (Balcı & Baloğlu, 2018; Balcı et al., 2020b; Tutkun Ünal & Deniz, 2016).

There is no significant difference in burnout syndrome levels according to the gender of the participants. In other words, the burnout syndrome scores of both men and women are close to each other. When the literature is examined, some studies support our results (Ardıç & Polatçı, 2008; Avcı & Şahin, 2017; Günaydın et al., 2023; Günher Arıca et al., 2011; Özdemir & Aslan, 2018). However, some studies found that burnout levels showed statistically significant differences according to gender (Badri et al., 2022; Sürgevil & Budak, 2005).

In this study, it has been determined that the gender of healthcare professionals creates a significant difference in terms of their social media addiction levels. Descriptive statistics results reveal that men have a higher value than women in terms of social media addiction level. When the literature is reviewed; there are studies similar to the result here, in Özdemir's (2019) study, it was determined that the social media addiction of the participants differed according to gender, except for the repetition sub-dimension, in other sub-dimensions and in the total scale, that is, male students' social media addiction levels were higher than female students. In Balcı and Gölcü's (2013) study, it is clearly seen that Facebook addiction categories differ significantly according to gender. However, in some studies, it has been concluded that social media addiction does not differ significantly according to gender and that the social media addiction scores of males and females are close to each other (Balcı et al., 2019; Balcı & Baloğlu, 2018; Demir & Kumcağız, 2019).

As a result of this study conducted on a sample of healthcare professionals, it was revealed that burnout syndrome has a positive significant effect on social media addiction. The results here are similar to other studies in the literature (Badri et al., 2023; Karaköse et al., 2022; Özdemir and Aslan, 2018). Avcı and Şahin (2017), who conducted a study on a sample of healthcare professionals, found that internet addiction was positively correlated with the emotional exhaustion and depersonalization sub-dimensions of burnout and negatively correlated with the self-actualization sub-dimension. Therefore, it was concluded that individuals experiencing burnout have a higher risk of internet addiction.

Another finding of the study is the differentiation in social media addiction according to educational status. Namely, the social media addiction level of secondary school graduates is higher than that of postgraduate graduates. It is also observed that the risk of social media addiction decreases as the age of the participants increases. In other words, as age increases, the use and interest in

technology may decrease, and the desire to share and interact through social networks may decrease. The results here are similar to other studies in the literature (Balçı et al., 2020a; Balçı et al., 2020b).

In conclusion, this study is very valuable as it is the first study to assess burnout and social media addiction simultaneously in the Turkish population. In addition, the findings of this study are very important in terms of showing increased levels of burnout and social media among healthcare professionals (physicians, nurses and others) and emphasizing the influence of these two factors. This study reveals that demographic factors such as marriage, education level, age and gender have significant effects on burnout and social media addiction. Given the importance and effects of social media addiction, more needs to be done to curb its spread among health professionals. Unfortunately, this is difficult because social media apps are readily available and easy to use anytime and anywhere. Therefore, the most effective way is to encourage self-control strategies. Similarly, given the importance and impact of burnout, action is needed to limit its spread. Burnout prevention programs should be developed to help health professionals cope with the syndrome. Such programs could include training in stress coping mechanisms and soft skills development sessions.

For the study, ethics committee permission document dated March 23, 2021 and numbered E.49691 was obtained from the Selçuk University Ethics Committee.

The study has been crafted in adherence to the principles of research and publication ethics.

The authors declare that there exists no financial conflict of interest involving any institution, organization, or individual(s) associated with the article.

The authors contributed equally to the entire process of the research.

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Can the Fixed-Cost Transportation Problem Be Solved with the Initial Solution Methods of the Transportation Problem?

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Abstract

From the dawn of humanity's existence to the present day and beyond, there will always be production and service systems to meet the demands at every point of consumption. In this context, transporting goods from production and service resources to consumption points will continue to play a significant role. Supply Chain Management and its sub-systems, particularly logistics and hence the Transportation Problem, will be crucial for the functioning of these systems. This study focuses on the Fixed-Cost Transportation Problem. A novel heuristic approach has been proposed for this problem, and the success of the heuristic has been analyzed through a group of test problems compared with similar methods in the literature. The proposed heuristic has shown promising results.

Keywords: *Fixed-Cost Transportation Problem, Transportation Problem, Heuristics, Vogel's Approximation Method (VAM), Modified Distribution Method (MODI).*

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1. INTRODUCTION

Logistics holds a critical significance in today's global and local industrial production and service systems, encompassing highly complex phenomena. The organizational success of an industrial system relies on the efficient management of both forward and reverse flows of materials, products, and information. The coordination and optimization of these processes are consolidated under the concept of Supply Chain Management (SCM). SCM encompasses networks designed to comprehensively address all stages, from sourcing a product or service to production processes, from production processes to storage, and from storage to distribution.

Before the U.S. Air Force made Leontief's work applicable to dynamic situations, Hitchcock (1941) and Koopmans (1947) independently addressed an intriguing special case. This specific scenario tackled by Hitchcock and Koopmans can be referred to as the Transportation Problem (TP). TP was initially proposed by Hitchcock in 1941 and by Koopmans in 1947 (Dantzig, 1951). TP and Fixed-Cost Transportation Problem (FCTP) constitute indispensable logistic process components to be considered in the operational dimension of SCM. TP aims to determine transportation routes and modes, most efficiently by modelling with linear programming, optimizing a multitude of variables. This optimization process targets cost minimization, efficient resource utilization, and operational efficiency. On the other hand, FCTP aims to develop the best transportation plan for materials and products within a specified cost constraint, taking into account the fixed costs of different transportation modes. FCTP is an NP-Hard problem, which implies that its mathematical models are solvable up to a certain dimension. Hence, studies in the literature focus on proposing solution approaches for FCTP utilizing various heuristic algorithms, and research on new solution approaches for FCTP is ongoing.

For professionals in both academic and industrial fields within the logistics domain, generating solutions for TP and FCTP that contribute multidimensional positive impacts such as minimizing supply chain costs, managing resources most effectively and efficiently, and enhancing customer satisfaction is crucial. Solving these operational problems enhances competitive advantage and positively affects business efficiency.

This research aims to propose initial solution approaches from a novel FCTP-specific perspective. In this context, the hypothesis is put forward that effective initial solutions for FCTP can be obtained by using classical initial solution methods employed for the TP. The rest of this paper is organized as follows: the second section provides a comprehensive analysis of the existing literature; the third section explains the details of the research methodology and provides an applied analysis based on the case study; and the final section discusses the contributions of the research and provides limitations.

2. LITERATURE REVIEW

The process of transporting homogeneous goods from production facilities in different geographical regions to warehouses located in various other regions in a way that meets supply and demand constraints, with the aim of minimizing costs, can be build a mathematically as a Linear Programming model. This approach is referred to as the TP. The mathematical modelling of the TP using Linear Programming was developed by George Dantzig in the year 1947.

The first general solution approach for the Fixed-Charged Transportation Problem (FCTP) was proposed by Balinski in 1961, which builds upon the Transportation Problem (TP) framework. In his work, Balinski suggested a solution by normalizing the minimum of supply and demand to the fixed charge, thereby obtaining a new cost matrix, and resolving the TP using this approach (Balinski, 1961). Numerous studies in the literature have either directly applied the Balinski approach or proposed alternative methodologies. Demircioğlu and Coşkun conducted a solution implementation of an FCTP industrial problem using the Balinski approach. In their study, the authors addressed a distribution problem for three supply centers and 24 demand points, regulating fixed and variable costs, as well as supply and demand quantities through the Balinski approach to solve this real-world problem. A comparison with the existing state revealed that the company achieved significant savings to a certain extent in the obtained solution (Demircioğlu & Coşkun, 2018).

Recent research in the realm of the TP has seen a somewhat limited exploration of initial solution propositions. Kirca and Satir (1990) were pioneers in proffering an inaugural solution for the TP, rigorously testing it across a spectrum of 480 distinct problem instances (Kirca and Satir, 1990). Khani et al. leveraged Kirca and Satir's foundational Total Opportunity Cost Matrix (TOCM) approach as the bedrock algorithm for their initial solution proposal (Khani et al., 2015). Karagül and Şahin advanced a novel starting solution methodology coined as KSAM, tailored specifically for the TP. Within this study, a meticulous comparative performance analysis of 24 designated test problems was undertaken, each assessed through a variety of distinct initial solution methodologies (Karagül and Şahin, 2020). Mutlu and colleagues introduced a method hinging on the minimization of the highest cost as a means of formulating inaugural solutions (Mutlu et al., 2022).

Mallick and their team took the case of the distribution of pharmaceuticals produced by pharmaceutical companies to regional warehouses as an exemplary scenario for addressing the TP. They managed to achieve optimal solutions using the Vogel's Approximation Method (VAM) and the Stepping Stone Technique (Mallick et al., 2023). Szkutnik-Rogoz and Małachowski introduced and implemented three different coding environments, namely R, Octave, and Matlab, for Linear Programming to obtain optimal solutions for the TP. They utilized initial solution approaches such as the northwest corner, the least cost in a matrix, and the VAM (Szkutnik-Rogoz and Małachowski, 2023).

Yılmaz and their research team concentrated on investigating initial solution approaches for TPs. They designed structures that incorporated the arithmetic, square root, and harmonic means of unit costs in the Tuncay Can Method, which relies on geometric averages preprocessing introduced in 2015 and conducted performance analyses (Yılmaz et al., 2023). Jamali and Rahman initiated a discussion on initial solution approaches for the TP, highlighting scenarios where the Least Cost Method (LCM) and VAM yield suboptimal solutions (Jamali and Rahman, 2023). Muhtarulloh and their colleagues carried out a comparative analysis of two existing initial solution methods, namely the Sumathi-Sathiya Method and KSAM, for a test dataset of 100 randomly generated TPs and shared their results (Muhtarulloh et al., 2022). Lestari and their team devised a distribution model for a company engaged in producing rubber-based materials for the TP. They initially obtained solutions using the North West Corner, Least Cost, and VAM, subsequently reaching optimal solutions with the Stepping Stone and Modified Distributions (MODI) approaches (Lestari et al., 2023). Akbar and their team harnessed an online data source where unit costs could be acquired for TPs, and they produced solutions using the North West Corner, Least Cost, and VAM. They suggested the North West Corner approach as a straightforward and efficient initial solution approach (Akbar et al., 2023). Abdelati proposed the Cost Quantity Method (CQM) as an initial solution approach for TPs. This method involves planning distribution on a unit cost matrix, where the smallest unit cost is calculated as a ratio (Abdelati, 2023). Tarigan and their colleagues compared two initial solution methods in the literature for Transportation Problems, TOC-SUM and KSAM. They argued the superiority of the KSAM approach over the TOC-SUM approach through comparisons of initial and optimal solutions (Tarigan et al., 2023).

Shivani evaluated TPs within a framework that could accommodate uncertainties arising from input data. In this context, she proposed a novel solution approach for the TP by addressing input data through a rough interval approach (Shivani, 2023b). Kalaivani and Kaliyaperumal prepared input matrices for solving with the MODI and VAM tools by introducing fuzziness to Transportation Problem input data using neutrosophic numbers and presented solutions (Kalaivani and Kaliyaperumal, 2023). Shivani and Ebrahimirjad suggested a solution approach for Unbalanced Transportation Problems created using rough interval fuzzy numbers (Shivani and Ebrahimirjad, 2023b).

Sarhani and their research team have diligently conducted a comprehensive literature survey in the realm of intuitive algorithms, initial solutions, and the domain of constrained and discrete optimization. Their endeavor illuminates recent strides in this area of study (Sarhani et al., 2022). Angmalisang and colleagues have introduced the Leaders and Followers Algorithm, designed to procure optimal solutions for Balanced TPs, subjecting it to a thorough comparative analysis against various methodologies. The fruit of their research shines brightly, showcasing a commendable degree of relative success, as evidenced across a diverse set of 138 test problems (Angmalisang et al., 2023). Aroniadi and Beligiannis have crafted two distinctive iterations of the Particle Swarm Optimization Algorithm, tailored specifically for the intricate art of solving the TP. Their ingenuity has led to the creation of

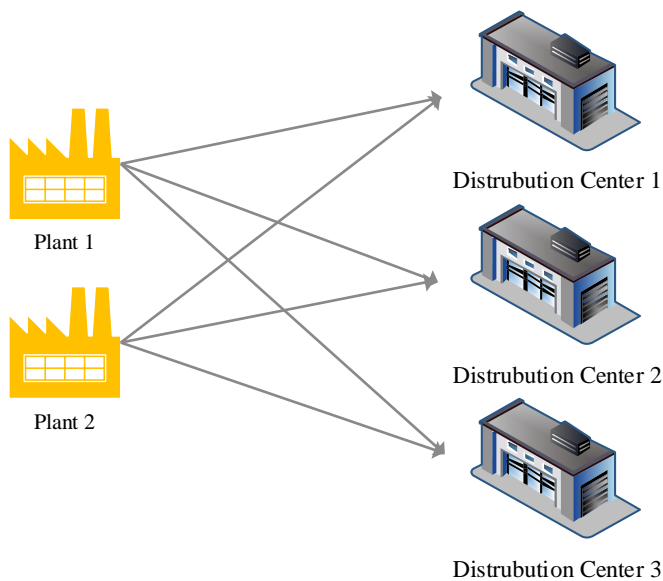
solutions that are both innovative and effective (Aroniadi and Beligiannis, 2023). In a groundbreaking contribution to the field, Shivani has proposed novel repair functions in tandem with network-based Genetic Algorithm approaches, particularly tailored for the Nonlinear FCTP. This breakthrough ushers in a new era of problem-solving methodologies (Shivani, 2023a). Shivani and Ebrahimnejad have jointly spearheaded a pioneering approach for tackling the complexities of the Multi-Objective Fractional TP, marking a significant advancement in this intricate field (Shivani and Ebrahimnejad, 2023a).

Karagül introduced a novel initial solution approach based on the KSAM approach, which is recommended as an initial solution methodology for the FCTP (Karagül, 2022). Yousefi et al. proposed an intuitive algorithm for solving the FCTP by utilizing priority-based GA, SA, and the Keshtel Algorithm (KA), incorporating four different consolidated cost calculation procedures. This algorithm resolves the consolidated cost matrices as standard Transportation Problems and selects the one with the lowest cost among the four solutions. When examining the comparative algorithm solution table, it becomes evident that solutions based on the consolidated cost matrix are more effective than others (Yousefi et al., 2017). Yousefi et al. recommended four intuitive algorithms for the FCTP, including Priority Based and Spanning Tree Based Simulated Annealing and Genetic Algorithm, resulting in the generation of solutions (Yousefi et al., 2018).

3. METHODOLOGY

In this section, we will first introduce the FCTP and its mathematical model. Subsequently, we will present the variable definitions for the proposed solution algorithm, outline the algorithm's steps, and illustrate the algorithm's solution process using a visual example.

Figure 1. Fixed-Cost Transportation Problem



Source: (Adlakha et al., 2018)

Yousefi et al., (2018) included the mathematical model in their article as follows:

$$\text{Min } Z = \sum_{i=1}^m \sum_{j=1}^n (c_{ij}x_{ij} + f_{ij}y_{ij}) \quad (1)$$

s. t.

$$\sum_{j=1}^n x_{ij} = a_i, i = 1, 2, \dots, m \quad (2)$$

$$\sum_{i=1}^m x_{ij} = b_j, j = 1, 2, \dots, n \quad (3)$$

$$x_{ij} \geq 0, \forall i, j \quad (4)$$

$$y_{ij} = \begin{cases} 1, & x_{ij} > 0 \\ 0, & \text{otherwise} \end{cases}, \forall i, j \quad (5)$$

If necessary, detailed information about the mathematical model can be obtained from the study of Yousefi et al., (2018).

3.1. Proposed Heuristics

The definitions of the nomenclature of the proposed heuristic are as follows.

Nomenclature

m : Number of supply centers

n : Number of demand centers

C : Unit variable transportation cost matrix (mxn)

F : Fixed cost per route matrix (mxn)

s : Supply vector ($mx1$)

d : Demand vector ($nx1$)

$norC$: Normalized C matrix between 1 and 2 (mxn)

$norF$: Normalized F matrix between 1 and 2 (mxn)

nsF : Cost per supply unit of $norF$ (mxn)

ndF : Cost per demand unit of $norF$ (mxn)

uC : Restructured unit cost matrix

Steps of the Proposed Heuristic

A1] Read the dataset. Read inC and inF matrices. These matrices represent unit variable transportation cost and fixed cost per route, respectively. They are associated with supply quantities and demand quantities.

A2] Preparation of problem data for solving through transformation.

Identification and configuration of input data, m , n , C , F , s , and d .

$$C = [c_{ij}]_{m \times n} \tag{6}$$

$$F = [f_{ij}]_{m \times n} \tag{7}$$

$$s = [s_i]_{m \times 1} \tag{8}$$

$$d = [d_j]_{n \times 1} \tag{9}$$

A3] Calculation of the normalized C matrix between 1 and 2.

$$norC = rescale(C, 1, 2) \tag{10}$$

A4] Calculation of the normalized F matrix between 1 and 2.

$$norF = rescale(F, 1, 2) \tag{11}$$

A5] Calculation of fixed costs per unit of supply and demand.

$$nsf_{ij} = \frac{norf_{ij}}{s_i}, \forall i, j \tag{12}$$

$$nsF = [nsf_{ij}]_{m \times n} \tag{13}$$

$$ndf_{ij} = \frac{norf_{ij}}{d_j}, \forall i, j \tag{14}$$

$$ndF = [ndf_{ij}]_{m \times n} \tag{15}$$

A6] Obtaining the restructured unit variable transportation cost matrix.

$$uC = norC + nsF + ndF \tag{16}$$

A7] Providing m , n , and uC to be integrated and solved with the (VAM+MODI) algorithm, and obtaining the solution.

A8] Calculation of the actual cost of the solution obtained with the (VAM+MODI) algorithm.

3.2. Illustrative Example

The illustrative example is constructed using the data provided in the Table 1 and Table 2 which is taken from Adlakha et al. (2006) article where the problem is referred to as $P10$.

A1] Read the dataset. Read inC and inF matrices.

Table 1. Unit Variable Transportation Costs

inC	$W1$	$W2$	$W3$	$W4$	Supply
$P1$	34	97	57	37	76
$P2$	99	49	8	70	83
$P3$	50	78	47	63	63
Demand	73	31	66	52	222

Source: (Adlakha et al., 2006)

Table 2. Fixed Costs per Route

<i>inF</i>	<i>W1</i>	<i>W2</i>	<i>W3</i>	<i>W4</i>	Supply
<i>P1</i>	91	47	44	68	76
<i>P2</i>	26	62	60	45	83
<i>P3</i>	57	40	32	96	63
Demand	73	31	66	52	222

Source: (Adlakha et al., 2006)

A2] Preparing the Read Problem Data for Solution through Transformation. Defining and configuring the input data as *m*, *n*, *C*, *F*, *s*, *d*.

Table 3. Number of Supply and Demand Centers

Variable	Value
<i>m</i>	3
<i>n</i>	4

Table 4. Unit Variable Transportation Costs

<i>C</i> matrix	<i>W1</i>	<i>W2</i>	<i>W3</i>	<i>W4</i>
<i>P1</i>	34	97	57	37
<i>P2</i>	99	49	8	70
<i>P3</i>	50	78	47	63

Table 5. Fixed Costs per Route

<i>F</i> matrix	<i>W1</i>	<i>W2</i>	<i>W3</i>	<i>W4</i>
<i>P1</i>	91	47	44	68
<i>P2</i>	26	62	60	45
<i>P3</i>	57	40	32	96

Table 6. Supply and Demand Quantities

	<i>P1</i>	<i>P2</i>	<i>P3</i>	-	Total
<i>s</i>	76	83	63	-	222
	<i>W1</i>	<i>W2</i>	<i>W3</i>	<i>W4</i>	Total
<i>d</i>	73	31	66	52	222

A3] Calculation of the *C* matrix normalized between 1 and 2

Table 7. Normalized Unit Variable Transportation Costs

<i>norC</i>	<i>W1</i>	<i>W2</i>	<i>W3</i>	<i>W4</i>
<i>P1</i>	1.2857	1.978	1.5385	1.3187
<i>P2</i>	2.0000	1.4505	1.0000	1.6813
<i>P3</i>	1.4615	1.7692	1.4286	1.6044

A4] Calculation of the F matrix normalized between 1 and 2

Table 8. Normalized Fixed Costs per Route

<i>norF</i>	<i>W1</i>	<i>W2</i>	<i>W3</i>	<i>W4</i>
<i>P1</i>	1.9286	1.3000	1.2571	1.6000
<i>P2</i>	1.0000	1.5143	1.4857	1.2714
<i>P3</i>	1.4429	1.2000	1.0857	2.0000

A5] Calculation of the Fixed Costs per Unit Supply and Unit Demand

Table 9. Distribution of Fixed Costs per Unit of Supply

<i>nsF</i>	<i>W1</i>	<i>W2</i>	<i>W3</i>	<i>W4</i>
<i>P1</i>	0.025376	0.017105	0.016541	0.021053
<i>P2</i>	0.012048	0.018244	0.0179	0.015318
<i>P3</i>	0.022902	0.019048	0.017234	0.031746

Table 10. Distribution of Fixed Costs per Unit of Demand

<i>ndF</i>	<i>W1</i>	<i>W2</i>	<i>W3</i>	<i>W4</i>
<i>P1</i>	0.026419	0.041935	0.019048	0.030769
<i>P2</i>	0.013699	0.048848	0.022511	0.024451
<i>P3</i>	0.019765	0.03871	0.01645	0.038462

A6] Obtaining the Reconfigured Unit Variable Transportation Cost Matrix

Table 11. Reconfigured Unit Variable Transportation Costs

<i>uC</i>	<i>W1</i>	<i>W2</i>	<i>W3</i>	<i>W4</i>
<i>P1</i>	1.3375	2.0371	1.5741	1.3705
<i>P2</i>	2.0257	1.5176	1.0404	1.7211
<i>P3</i>	1.5042	1.8270	1.4623	1.6746

A7] Providing m , n , and uC for an Integrated Solution Using the (VAM+MODI) Algorithm and Obtaining the Solution

Table 12. (VAM+MODI) Assignment Solution

Optimal	W1	W2	W3	W4	Total	Supply
P1	24	0	0	52	76	76
P2	0	17	66	0	83	83
P3	49	14	0	0	63	63
Total	73	31	66	52	222	-
Demand	73	31	66	52	-	222

Table 13. Calculated Real Costs for the (VAM+MODI) Solution

Explanation	Results
Proposed Approach Solution Cost	8021
Article Solution (Adlakha et.al.2006)	8021
Deviation (%)	0

3.3. Performance Analysis of the Proposed Heuristics

Test problems were obtained from Yousefi et al. (2017). The structural properties of the dataset and data generation parameters are provided in Table 14.

Table 14. Fixed-Charge Transportation Test Problems Characteristics

Problem size	Total	Problem	Range of variable costs		Range of fixed costs		
			Lower limit	Upper limit	Lower limit	Upper limit	
Small	5 × 10	5000	A	3	8	50	200
	10 × 10	8000	B	3	8	100	400
	10 × 20	10000	C	3	8	200	800
Medium	15 × 15	15000	D	3	8	400	1600
	10 × 30	15000					
	20 × 30	20000					
Large	50 × 50	50000					
	30 × 100	30000					
	50 × 200	50000					

Source: (Yousefi et.al.,2017)

In the study by Yousefi et al. (2017), the authors compared three different heuristic algorithms, including one they developed themselves, with solutions generated by Lingo. To perform a fair comparison, gaps in the Lingo solutions were subtracted to create a Best Known Solution (BKS) definition for the problems. The deviations presented in the results table provided by the authors were

also calculated again with BKS as the reference. The performance of the proposed method was similarly assessed using BKS as the reference. Yousefi et al. (2017) presented solutions from Genetic Algorithm (GA), Simulated Annealing (SA), Keshtel Algorithm (KA), a new algorithm proposed by the authors named Heuristic Consolidated Cost (HCC), and Lingo solutions in Table 15.

Table 15. Comparison Table of Solution Results

P. Group	P. Size	Lingo	BKS	GA	SA	KA	HCC	Proposed Algorithm
A	5×10	21810	21810	21935.8	22299.1	21873.1	21850	21906
	10×10	28401	28401	28813.5	29525.35	28908.6	28435	28494
	10×20	35372	35372	36951.9	37800.75	37079.9	35558	35558
	15×15	49955	49955	52376.3	53709.6	52133.1	50030	50044
	10×30	50830	50830	52594.5	53229.95	52323	50956	52392
	20×30	65270	65270	67897.9	68695.4	68887.6	65676	65676
	50×50	158856	158681.2584	162212.6	164213.3	163422.1	158684	158668
	30×100	102207	102207	104571.4	105763.1	105496.1	102260	104112
	50×200	173151	168372.0324	171823	172999.5	172543.3	168496	170750
Average		76206	75655	77686	78693	78074	75772	76400
B	5×10	24348	24348	24434.1	24990.25	24476.15	24725	24725
	10×10	31017	31017	31304	31940.55	31302.85	31333	31333
	10×20	39858	39858	40644.5	40926.8	40547.95	40252	42117
	15×15	58766	58766	60148	60689.8	60330.05	58932	59110
	10×30	60445	59344.901	62441.5	63150.85	62835.2	59362	60917
	20×30	70740	70740	72331.4	73034.1	72478.05	70759	70918
	50×50	167981	167258.6817	172111.3	173574.8	172359.3	167260	167099
	30×100	112122	112122	115098.5	116308.6	115591.3	112289	112313
	50×200	192867	186174.5151	192000.9	194021	192974.2	186393	192716
Average		84238	83292	85613	86515	85877	83478	84583
C	5×10	25296	25296	25401	26025.05	25418.35	25338	25461
	10×10	36873	36873	37544	38093.65	37584.2	37844	37359
	10×20	44645	44645	45883.7	46570.35	45874.25	45443	46492
	15×15	58725	58725	60685	61285.05	60333.05	59319	59614
	10×30	63258	63258	64674.7	65375.85	64917.25	64159	64331
	20×30	78237	78237	81147.1	82099.25	81213.15	79835	79841
	50×50	185074	184074.6004	187934.3	189080.1	188735.7	184083	182606
	30×100	132153	131796.1869	135643.6	136937.2	136038.5	131800	134092
	50×200	233710	220365.159	227418.2	229242.5	228110.2	221096	229009
Average		95330	93697	96259	97190	96469	94324	95423
D	5×10	30107	30107	30313.8	31436.3	30392.7	30836	31228
	10×10	39760	39760	40150.4	41224.75	40128.25	41013	41751
	10×20	60267	60267	62000.2	62720.35	62066.75	63133	64784
	15×15	73913	73913	76503.5	77622.4	76764.7	75829	74884
	10×30	80971	80971	82872	84249.8	83175	82705	85275
	20×30	99204	98985.7512	100622.2	102059.3	101144.6	102203	105881
	50×50	218209	215765.0592	218694.7	220083	219398.2	215793	220838
	30×100	171059	170528.7171	174298.8	177568.4	176040.5	170533	176590
	50×200	308963	285481.812	298771.8	303272.1	301846.3	287137	310552
Average		120273	117309	120470	122248	121217	118798	123531

The deviation values of the solution values in Table 15 from the BKS are shown as percentages in Table 16 and Figure 2.

Table 16. Comparison of Solutions with BKS

P. Group	P. Size	Lingo Dev (%)	GA Dev (%)	SA Dev (%)	KA Dev (%)	HCC Dev (%)	Proposed Heuristic Dev (%)
A	5×10	0.00	0.58	2.24	0.29	0.18	0.44
	10×10	0.00	1.45	3.96	1.79	0.12	0.33
	10×20	0.00	4.47	6.87	4.83	0.53	0.53
	15×15	0.00	4.85	7.52	4.36	0.15	0.18
	10×30	0.00	3.47	4.72	2.94	0.25	3.07
	20×30	0.00	4.03	5.25	5.54	0.62	0.62
	50×50	0.11	2.23	3.49	2.99	0.00	-0.01
	30×100	0.00	2.31	3.48	3.22	0.05	1.86
	50×200	2.76	2.05	2.75	2.48	0.07	1.41
	Average	0.32	2.83	4.47	3.16	0.22	0.94
B	5×10	0.00	0.35	2.64	0.53	1.55	1.55
	10×10	0.00	0.93	2.98	0.92	1.02	1.02
	10×20	0.00	1.97	2.68	1.73	0.99	5.67
	15×15	0.00	2.35	3.27	2.66	0.28	0.59
	10×30	1.82	5.22	6.41	5.88	0.03	2.65
	20×30	0.00	2.25	3.24	2.46	0.03	0.25
	50×50	0.43	2.90	3.78	3.05	0.00	-0.10
	30×100	0.00	2.65	3.73	3.09	0.15	0.17
	50×200	3.47	3.13	4.21	3.65	0.12	3.51
	Average	0.72	2.42	3.66	2.66	0.46	1.70
C	5×10	0.00	0.42	2.88	0.48	0.17	0.65
	10×10	0.00	1.82	3.31	1.93	2.63	1.32
	10×20	0.00	2.77	4.31	2.75	1.79	4.14
	15×15	0.00	3.34	4.36	2.74	1.01	1.51
	10×30	0.00	2.24	3.35	2.62	1.42	1.70
	20×30	0.00	3.72	4.94	3.80	2.04	2.05
	50×50	0.54	2.10	2.72	2.53	0.00	-0.80
	30×100	0.27	2.92	3.90	3.22	0.00	1.74
	50×200	5.71	3.20	4.03	3.51	0.33	3.92
	Average	0.72	2.50	3.76	2.62	1.04	1.80
D	5×10	0.00	0.69	4.42	0.95	2.42	3.72
	10×10	0.00	0.98	3.68	0.93	3.15	5.01
	10×20	0.00	2.88	4.07	2.99	4.76	7.49
	15×15	0.00	3.50	5.02	3.86	2.59	1.31
	10×30	0.00	2.35	4.05	2.72	2.14	5.32
	20×30	0.22	1.65	3.11	2.18	3.25	6.97
	50×50	1.12	1.36	2.00	1.68	0.01	2.35
	30×100	0.31	2.21	4.13	3.23	0.00	3.55
	50×200	7.60	4.66	6.23	5.73	0.58	8.78
	Average	1.03	2.25	4.08	2.70	2.10	4.95

When we examine Table 16, the first column displays the gaps of the Lingo solver compared to the optimal solutions. Successively, the deviations from BKS results as a percentage are presented for GA, SA, KA, HCC, and the Proposed Heuristic. The Proposed Heuristic outperformed the GA, SA, and KA algorithms for the A, B, C, and D group problems. Furthermore, the HCC algorithm appears to be quite competitive in solving A, B, and C group problems. However, it can be observed that it loses competitiveness in solving D group problems, where the fixed costs are defined in a high range. Nonetheless, it is clear that for HCC and the Proposed algorithm, deviations increase from Group A to D. However, for GA, SA, and KA, it's not as clear to say that this deviation is increasing significantly. The percentage deviation values of the solutions provided by the methods in Table 16 for different

problem groups from the best solution are presented in Figure 2, Figure 3, Figure 4 and Figure 5, respectively.

Figure 2. Deviations from the best solutions for problem group A (%)

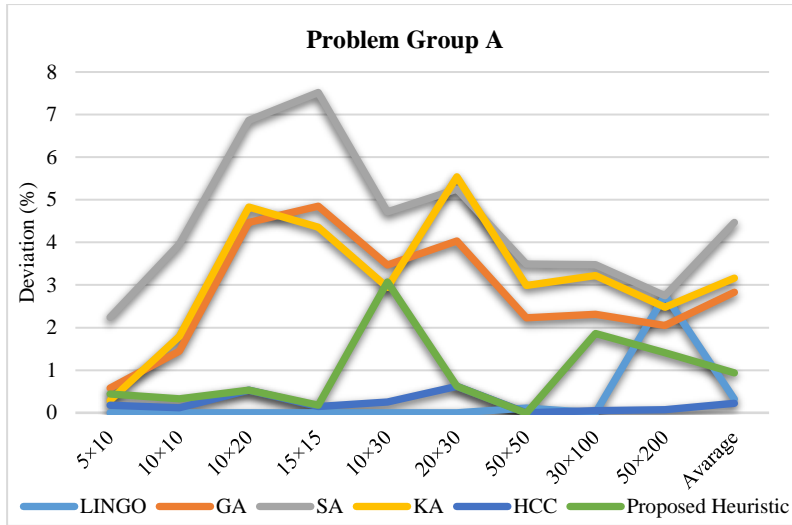


Figure 3. Deviations from the best solutions for problem group B (%)

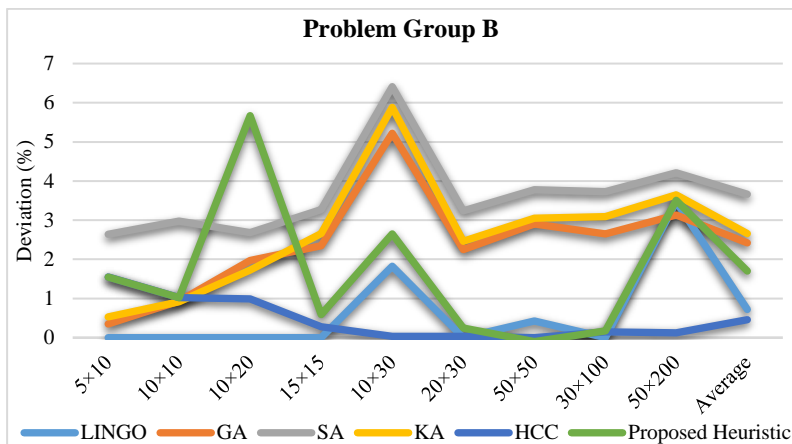


Figure 4. Deviations from the best solutions for problem group C (%)

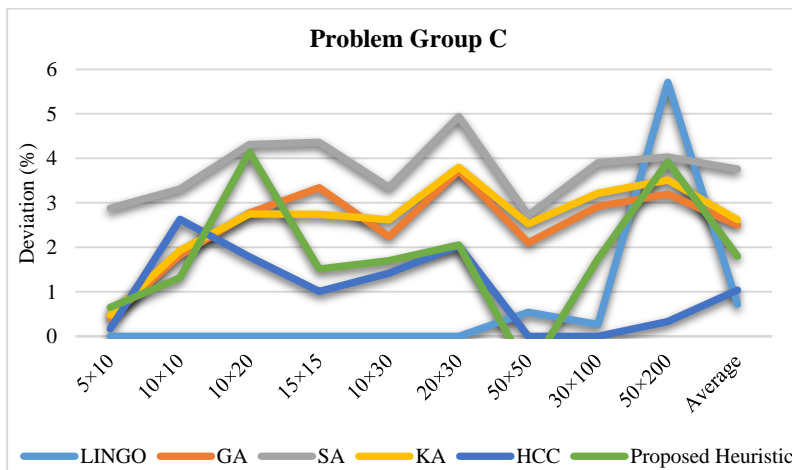
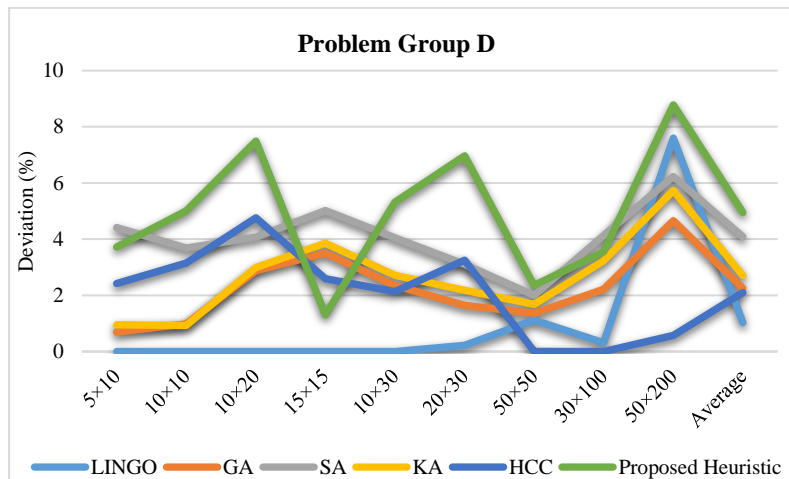


Figure 5. Deviations from the best solutions for problem group D (%)



4. CONCLUSION

The study addresses the Transportation Problem and Fixed-Cost Transportation Problem, which are critical issues in the logistics industry. The Fixed-Cost Transportation Problem, being classified as NP-Hard, becomes more challenging to solve with increasing problem size when utilizing mathematical methods. Examination of test problems reveals that the Lingo mathematical solver encounters difficulties in solving medium-sized problems and fails to reach optimal solutions for larger problem instances. Consequently, heuristic algorithms and novel approaches play a significant role in solving Fixed-Cost Transportation Problems.

In this research, a new variable transportation cost matrix is developed by employing certain heuristic operations based on unit variable transportation cost and fixed-cost matrices for the Fixed-Charge Transportation Problem. The study demonstrates efforts to reach optimal solutions using the VAM and the MODI. The results obtained in this study suggest that the proposed heuristic approach offers promising solutions compared to the literature. When examining the deviations of problem groups in comparison to the BKS, it is observed that all groups yield deviations less than 5%.

These findings indicate that various heuristic methods based on the proposed approach can be utilized to produce effective solutions in the logistics industry. For future research, these and similar approaches can be recommended as new research methodologies, potentially paving the way for further developments in this field.

The study does not necessitate Ethics Committee permission.

The study has been crafted in adherence to the principles of research and publication ethics.

The author declares that there exists no financial conflict of interest involving any institution, organization, or individual(s) associated with the article.

The entire work was carried out by its only, stated author.

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Prosumer Neo-Tribes: An Ethnography of Recreational Cycling Communities * **

Kübra AŞAN¹, Medet YOLAL²



Abstract

In postmodern community studies, a neo-tribal theoretical framework has been proposed to elucidate recreational and touristic communities, positing that neo-tribes coalesce around shared consumer experiences. This study diverges by examining the productive functions of recreational and tourist communities through the lens of prosumerism. The study investigates two distinct recreational cycling tribes in Türkiye using ethnographic methods and participatory observations. The findings highlight that these cycling tribes play active roles in organizing events, developing visitor experiences and destinations, and generating both economic and social benefits. This study introduces the concept of prosumer tribes within the leisure and tourism literature, supported by empirical evidence. It offers implications for policymakers and businesses seeking to understand and harness the prosumer dynamics within recreational cycling communities.

Keywords: *Tourism, recreation, cycling communities, neo-tribes, prosumer.*

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1. INTRODUCTION

Neo-tribalism, pioneered by Maffesoli (1996), has become a theoretical perspective often used to explain community forms of leisure and tourism behaviour (Hardy et al., 2018; Pforr et al., 2021). Neo-tribes are defined as groups of people from different walks of life who meet physically or virtually in fluid groupings, bound by common interests, similar lifestyles, rituals and language (Hardy et al., 2013).

In the leisure and tourism literature, studies initially applied the neo-tribe approach to describe communities in various leisure and tourism settings, such as football fans (Hughson, 1999), urban dance music enthusiasts (Bennett, 1999), surfers (Moutinho et al. 2007), cruise tourists (Weaver, 2011), festival goers (Hannam & Halewood, 2006) or recreational vehicle (RV) users (Hardy et al. 2012), and more recent studies have focused on more specific themes such as neo-tribe formation (Hardy et al. 2021), collective space (Canosa & Bennet, 2021; Vorobjovas-Pinta & Lewis, 2021), cohesion (Asan et al. 2022) or political resistance (Caldicott, 2021). However, as the literature largely conceptualises and explains neo-tribes in terms of consumerism, their productive functions as sectoral actors are ignored and remain to be explored.

On the other hand, neo-tribes include people who not only make the same types of purchases, but may also participate to some extent in the production process (Weaver, 2011). Hardy et al (2021) state that tribes produce a range of identities, practices, rituals, meanings and even material culture itself. Sykes (2021) also claims that if the market does not provide the desired products and services, the tribe will co-create an authentic tribal experience. Similarly, Goulding et al. (2013) highlight that consumers are seen as active co-creators of value, rather than passive recipients of value that firms create and embed through their ability to design and produce goods and services with utility, which are then traded in the market and consumed by consumers. Thus, although neo-tribes are formed around consumption patterns (Maffesoli, 1996), they do not remain simply consumers as a result of the intertwining of production and consumption. Recently, Cova and Dalli (2018) have opened up the concept of prosumer tribes for discussion. Accordingly, prosumer tribes shape the future of consumer culture, including hybrid practices such as helping, recycling, surfeiting or volunteering from a collective perspective. These studies provide clues to the productive aspect of leisure tribes, but are insufficient to explain the prosumer aspect of these socialites and are limited in terms of empirical evidence. To fill this gap, this study examines the supplier characteristics of leisure and tourism tribes, rather than consumer communities, using the prosumer framework. The study aims to explore the productive functions of two different recreational cycling tribes in Türkiye.

An ethnographic approach was adopted for the purpose of the study. The results of the study are expected to shed light on leisure and tourism communities. In addition, the study will allow certain implications to be drawn for businesses and decision makers regarding the prosumer characteristics of recreational cycling communities.

2. LITERATURE REVIEW

2.1. Prosumerism

Prosumption, first proposed by Toffler (1981), is essentially described as the intertwining of production and consumption spheres. The rise of prosumption has been explained by the development of new production technologies and DIY (do-it-yourself) consumption practices (Toffler, 1981; Ritzer 2015), the increasing cost of non-automated services (Toffler, 1981), web 2.0 technologies (Ritzer & Jurgenson, 2010), network-based marketing approaches (Kotler, 1984) and the emergence of more individual, hedonistic and creative consumers, as opposed to traditional consumers (Cova & Cova, 2012). The prosumer is used interchangeably in the literature with concepts such as co-creator (Prahalad & Ramaswamy, 2004), post-consumer (Firat & Dholakia, 2006) or market partner (Prahalad & Ramaswamy, 2004). Prosumers can be defined as individuals who consume and produce value, either for their own consumption or for consumption by others, and may receive implicit or explicit incentives from organisations involved in the exchange (Lang et al., 2021).

According to Ritzer and Jurgenson (2010), production and consumption should not be considered separately, as they include each other at different levels. As this strengthens the identification of prosumers, some studies have developed different prosumer typologies (Lang et al 2021; Perera et al 2020; Ritzer, 2015). For example, Lang et al (2021) have described prosumers in six categories based on their role in the Covid-19 crisis period (DIY prosumers, self-service prosumers, customising prosumers, monetised prosumers, collaborative prosumers, economic prosumers). Another study, Perera et al. (2020), concluded that green prosumers can be categorised into three levels, including contraction, control and creation.

There are studies in the hospitality, tourism and leisure literature that define and categorise prosumers (Ritzer, 2015; Sugihartati, 2020). However, a few studies have focused on the prosumerism of leisure communities (Bond et al. 2021; Lahav-Raz, 2019). For example, Bond et al (2021) examined the network structures that included *#ToiletRollChallenge* and *#ProjectRestart* as prosumed recreational activities during the COVID-19 shutdown. They introduced the concept of prosumption value by claiming that prosumption is naturally linked to networks of relationally interacting individuals. According to these, leisure is relational and prosumed leisure (Bond et al. 2021). On the other hand, leisure communities can be studied as areas of prosumer engagement, not only in terms of online representation, but also in terms of face-to-face interaction. As a result, it is understood that the studies investigating prosumer communities as industry stakeholders are limited.

2.2 Neo-Tribes in Hospitality, Leisure and Tourism

The neo-tribe theory, developed by Maffesoli (1996), explains postmodern communities in terms of consumerism. According to Maffesoli (1996), the mass society based on class-specific consumption patterns broke down in the rising consumer society that was clearly evident in the 1990s.

It was replaced by more heterogeneous consumption patterns and socialisations based on new group formation dynamics. These socialisations have been defined as neo-tribes, referring to communal values such as emotionality, solidarity and symbolism (Maffesoli, 1996; Cova & Cova 2001). Neo-tribes are conceptualised as groups of people from different walks of life who meet physically or virtually in fluid groupings (Hardy et al., 2013; Hardy, 2021). In this regard, neo-tribe studies tend to describe consumption groups that emerge based on social solidarity based on collective identities and shared experiences, rather than class-based understandings (Lv & Qian, 2018).

On the other hand, neo-tribes are inherently prone to co-creation (Canniford, 2011; Cova & Dalli, 2018). In tribes, individuals transform the consumed object, which opens the way to a creative culture that revitalises the social ethos (Seraphin & Korstanje, 2021). With characteristics of plurality, playfulness, transience and entrepreneurialism (Cova et al., 2012), tribes remain in a state of co-creation with all kinds of market resources (Canniford, 2011; Scuttari et al., 2021). Consumer tribes are entrepreneurial because they generate innovative ideas for business ventures and act as a collective in marketing (Scuttari et al. 2021). In addition to entrepreneurship, Cova & Dalli (2018) argue that communities act as guardians of the market value created by consumers. They develop tactics to compete for market share and redistribute profits within the community. Tribes can also create an authentic tribal experience when the market fails to provide desired products and services (Sykes, 2021). Communities engage in market relations that change their own form, content and practices (Moufahim et al. 2018). In this respect, neo-tribes can play an active sectoral role, rather than simply being consumers.

Moreover, tribes do not always have to be made up entirely of consumers. Communities generate communal relationships and create feelings of ease, well-being, satisfaction, excitement and passion that permeate their joint activities, as well as cultural values such as ideas, symbols, codes, texts, linguistic figures and images that are then put into their activities (Cova and Dalli, 2018). Communities also provide sources of support, therapy and coping, as well as political engagement and resistance in market societies (Moufahim et al., 2018). For example, tribes can be the sites of representation of different social identities (Vorobjovas-Pinta, 2018; Sykes, 2021), and they also produce contested spaces with ideological bases against hegemony (Hayday et al., 2021; Hughson, 1999). The idea of community as a key component of social welfare planning, as a way of organising service delivery and health care, and as a way of engaging a range of actors, including non-profits, businesses and working-class communities in particular places (Moutinho et al., 2007). Thus, neo-tribes that can generate social and economic value should be considered not only as sectoral actors, but also as social actors that transcend sectoral boundaries.

In the leisure and tourism literature, some studies point to important implications regarding the productive functions of neo-tribes. First, the events organised by the tribes and conceptualised as rituals can be considered as production items. Studies show, for example, that tribes organise events such as

voluntary races (Dolles et al., 2018), vegetarian food festivals (Bertella, 2018), pride events (Vorobjovas-Pinta, 2018) or cycling tours (Asan et al. 2022).

Second, leisure experiences can be produced through the interactions of tribe members, sometimes without the need to purchase from a service provider company. Experience-based marketing argues that experiences as economic units can be designed and presented like products (Pine & Gilmore, 1999). Experience-based marketing research suggests that experiences can be co-created to enhance link value (Cova & Dalli, 2018; Sykes, 2021). Similarly, in leisure and tourism tribes, experiences are formed through the interactions of members. In a recent study, Sykes (2021) also studied motorcycle tribes and concluded that members from different backgrounds co-create their experiences with dynamic fluidity. Furthermore, Sykes (2021) claimed that the formation of a tribe can occur through co-created experiences in the group. Dolles et al (2018) found that tribe members benefited from the value of the event in a co-creative manner, despite playing various roles such as spectators, volunteer facilitators and race participants in a racing event.

Finally, recent studies focusing on space and tribal relations shed light on the functions of tribes in producing space and/or place (Canosa & Bennet, 2021; Hayday et al 2021; Vorobjovas-Pinta & Lewis, 2021). For example, Hayday et al (2021) concluded that esport communities have a production space that involves multiple and diverse stakeholders, all of whom appear to share imperatives and form productive relationships. In the context of watersports tribes, Scuttari et al (2021) found that members act as inventors of new symbols on the site and become enjoyable co-creators of destination spaces by sharing individual experiences on a community basis. Furthermore, tribe members who perform their rituals in physical spaces attach meaning to these places, transforming them into anchoring places that foster a sense of belonging (Cova & Cova 2002; Lv & Qian 2018; Wang & Xie, 2021). Thus, anchoring places can be considered as attractive destinations for tribal members.

Based on the literature discussion, we assume that recreational neo-tribes have production functions, in a sectoral and social sense, rather than just consumption. We therefore focus on exploring the productive functions of neo-tribes.

3. METHOD

3.1. Research Design

Based on the neo-tribal theoretical framework, the study questions the conceptualisation of recreational communities as prosumers and aims to explore the productive functions of tribes in the case of recreational cycling communities. In this regard, an ethnographic approach was used to study the two recreational cycling neo-tribes in Türkiye. Ethnography is a convenient method to obtain information about tribal rituals and tribal values (Creswell, 2015). Ethnography can capture multifaceted sentiments and reveal the values at the core of neo-tribalism (Vorobjovas-Pinta 2018). In addition, ethnographic

methods are often used in neo-tribal studies (Hardy, Bennett, and Robards, 2018), so the present study follows this approach.

The data was collected by one of the researchers who was a member of these groups, both physically and through social media. In person, she attended events organised by the cycling communities. She also frequently interacted with members by following their social media pages. In this way, the researcher built trust and learned about the neo-tribal culture through long-term interactions.

3.2. Research Site

The growth of cycling tourism in Türkiye has been actively influenced by cycling communities (Çelik Uğuz, 2018). The vast majority of tourism events, tours and festivals have been planned by cycling communities in Türkiye (Bisiklopedi, 2023). In this regard, two different cycling communities that represent the sociality of cyclists in Türkiye at the national level were included in the study.

The first is the Izmir Ancient Cities Cycling Tour Community (ABAK), which started organising cycling tours in 2012 and holds them every year in April. With a group of 100 bikes, the five-day tour follows a path through the ruins of ancient cities around İzmir. The event is advertised on Facebook. Participants pay a fee to cover the cost of food and drink, camping and guides. The tour itself is an addition that mixes cycling, nature, historical sites and cultural elements. The tour also includes social responsibility initiatives. For example, during the 2015 edition, free bicycles were distributed to needy children in the villages along the route. Cycling fans come together physically during the ABAK Tour, but they also stay in touch online via the ABAK Facebook page.

The second is the Eskisehir Bicycle Association (Velesbid), which was founded in 2014 as a non-profit organisation. The organisation arranges seminars, workshops, events/activities that focus on social responsibility, local night tours, tours within and outside the city, camping tours and more. The group hosts participants from many cities during its nationwide "Eskisehir Bicycle Festival" and "Eskisehir Bicycle Gatherings" events. Individuals can apply for formal membership. Members pay a nominal annual fee of \$10. Facebook is used for communication between members and followers. Any Facebook user who is not a member can participate in the association's activities as membership is not required. All activities and meetings are voluntary and open to all.

3.3. Data Collection

Data was collected through participant observation. The study data consists of observation notes and data from the communities' social media pages. The study used theoretical sampling, which involves selecting participants, cases or contexts based on their potential to contribute to the development and refinement of theoretical concepts. When the emerging concepts and processes began to recur, the observations were completed.

In the case of Velesbid, the researcher conducted participant observations as an active member for 16 months between September 2016 and December 2017. Similarly, participant observation was conducted during the ABAK tour, which took place from 22 to 25 April 2017. The researcher took observation notes by cycling to the events several times during the weeks. At the community events she attended, the researcher recorded short observation notes and audio notes in her own voice due to time constraints. After the events, she expanded on these notes to form the observation data file.

The content of the Facebook pages of the two communities was also captured using the NCapture programme. The groups' social media pages provided a rich source of data for the study, containing members' expressions of their experiences, as well as photos and videos. 6,652 Velesbid posts and 5,344 ABAK posts were made since the pages were created. A total of 11,995 posts were collected over a period of about five years. In this way, the triangulation required by qualitative research was achieved, and a holistic view was adopted, in keeping with the nature of ethnography. The permission of the community managers allowed the data to be collected.

3.4. Data Analysis

The data were processed using thematic analysis. A three-stage coding procedure (Strauss & Corbin, 1990) was used using NVivo software, including open, axial and selective coding. Similarities and differences and cutting and sorting techniques were used to identify themes (Glaser & Strauss, 1967). Themes were labelled based on the literature review. The coding of themes was repeated by two tourism academics until a consensus was reached. The initial coding had an interrater reliability of 81% according to Miles and Huberman's (1994) interrater reliability formula.

4. RESULTS

The analysis explained the productive functions of tribes through five themes: event development, experience development, developing destinations, economic benefit and social benefit.

4.1 Event Development

The results of the study showed that cycling neo-tribes organise tourist events that include food and drink, accommodation and guide services. ABAK is already a community formed around a touring event. Every year in April, 100 domestic and foreign participants who are waiting to visit the ancient cities in and around Izmir come together with this organisation. The organisation does not allow the same person to participate two years in a row in order to ensure the circulation of participation. The core team of volunteers is responsible for organising the event. During the event, many services are volunteered by the participants, such as food service, guide service or bike maintenance and repair. Sample photos of ABAK events obtained from online data provide evidence of the themes discussed, as shown in Figure 1.

Figure 1. ABAK tour photos



a) Community banner; b) 23rd of April, National Sovereignty and Children's Day in Köselier Village; c) Gift bikes for kids; d) Food service by local business; e) Cycling in nature; f) Visiting attractions

Source: (ABAK Facebook Page, n.d.)

Velesbid also organises two national events: Eskisehir Bicycle Festival and Eskisehir Bicycle Meetings. In addition, Velesbid organises recreational events: out-of-town tours with camping, overnight camping tours, day tours, night tours, activist tours (cycle paths, end violence against women or International Day of People with Disabilities), national festival tours (Republic Day on 29 October and 19th May the Commemoration of Atatürk, Youth and Sports Day) and other events (cultural events,

hiking, social responsibility events). Examples of event photos taken from the Facebook page of this community are shown in Figure 2.

Figure 2. Velesbid tour photos



a) March 8 international women's day tour; b) The Velesbid Bicycle House; c) International guests at the Velesbid Bicycle House; d) EU project meeting "Cycling for all" with other NGOs; e) Co-pedal cycling with visually impaired on 19th May the Commemoration of Atatürk, Youth and Sports Day; f) Bicycle maintenance and repair workshop ;g)Eskisehir Bicycle Gatherings

Source: (Velesbid Facebook Page, n.d.)

4.2. Experience Development

In the cycling tribes studied, members have a variety of experiences during social interactions. After coding, the experiences observed in the cycling tribes are presented in Table 1. The Recreation Experience Preference Theory (REP) (Driver & Tocker, 1971), which is widely cited in the leisure literature, was used to determine the sub-themes of experiences. In addition to these experiences, 'belonging', 'collective enthusiasm', 'solidarity' and 'lifestyle' experiences are identified based on neo-tribe theory (Maffesoli, 1996).

Table 1. Experiences in cycling neo-tribes

Experience sub-theme	Original statement example
Belonging	I am in the joy of completing a beautiful event without any problems. What I really felt was a sense of belonging to the group. We went to a pub after the tour. Actually, this venue was not a place I go to very often. But now it felt like a more familiar place than ever before. I enjoyed the togetherness with the positive emotions radiated by the people around me. (Observation, Velesbid, 18.12.2016).
Collective enthusiasm	After registration and introduction in the city square, the tour will begin. The registered participants started to cycle around the Izmir Clock Tower, an iconic structure in the area. This is a kind of ritual. By the time of departure, people are warming up. Thus, they initiate a stream of energy. They attract the attention of other people around and everyone is already starting to smile. (Observation, ABAK, 21.04.2017).
Solidarity	"We are proud to be a part of this event . . . We stand in awe of the ABAK team, their solidarity and great effort." (Online, ABAK, 26.04.2013)
Lifestyle	(After I started cycling) I try to drink more water and eat fruit. I think I should take care of myself. (Observation, Velesbid, 12.12.2017).
Entertainment	"The Phrygian valley tour, in Yazılıkaya. We had a lot of fun; we were not bothered by the rain. We kept cool and had a blast..." (Online, Velesbid, 07.08.2017).
Enjoy nature	"It is such a wonderful feeling to be among these beautiful people with the lyrical sound of pedals and sweet smells of spring flowers" (Online, ABAK, 25.04.2015)
Physical fitness	"Even though our bodies are aching now... our soul is looking forward to the next year's tour." (Online, Velesbid, 27.04.2015).
Physical rest	One of the cyclists says that 'Cycling is like yoga for me... The wheels are starting to turn, you don't hear the sounds outside... You start to relax'. (Observation, ABAK, 22.04.2017).
Escape	"You can relax. You can stay away from very troubled and stressful environments." (Online, Velesbid, 12.04.2017).
Learning	Participants not only discover nature, but they also learn how to spend the night in nature. They get to know about camping and equipment use. (Observation, Velesbid, 23.09.2016).
Meet new people	In the beginning, the new participants are silent... but there is no exclusion. As time passes, the conversation begins. A small talk begins about a bike brand or a piece of equipment... Biscuits are shared during the break. (Observation, Velesbid, 20.09.2017).
Share similar values	Many people participate in tours to find new friends and socialize. In time, they share leisure time with these new friends outside of cycling in other ways (for example going out, going to the cinema or theatre, or going on holiday). (Observation, Velesbid, 23.09.2016).

Table 1 (Cont.)

Experience sub-theme	Original statement example
Independence	One of the participants explained this independence as the biggest contribution of festivals and tour engagement. It gives self-confidence to those who want to make long journeys by bike.” (Observation, ABAK, 21.04.2017).
Introspection	A participant says that ‘cycling... to take time for yourself, to be alone with yourself, even if you are in a group, you can be alone with yourself’. (Observation, Velesbid 23.07.2016).
Achievement	“Even though it looks like we've been eating all day... we've done great, meaningful work together (a comment to photos).” (Online, Velesbid, 05.09.2015).
Risk reduction	“It feels safe to cycle de in heavy traffic with a group. Tour attendants check all participants on the ride. Moreover, everyone is watching each other.” (Observation, Velesbid, 27.06.2017).
Be with considerate people (social security)	Especially women who participate in group activities feel socially safe as well as physically secure. They want to be with people they know and like. (Observation, Velesbid, 12.02.2017).

According to the results, some of the experiences observed, such as physical relaxation or independence, escape, are a natural consequence of the act of cycling. Other experiences, such as meeting new people, collective enthusiasm or solidarity, are a result of collectivity. In this context, both individualistic and collective experiences can be seen simultaneously in cycling tribes. This finding suggests that tribes have a rich spectrum as an experience platform.

4.3. Destination Development

Another notable finding relates to the production space function of cycling tribes. In both cases, the routes and arrival points that are frequently visited in cycling tour programmes have, over time, turns into common tourist or recreational destinations. In ABAK, there are two tour routes to the south and north of Izmir. These routes are planned to include the historical, cultural and archaeological attractions of the region. One of the pioneers of ABAK expressed this situation in a contribution as follows:

“We have worked with the foresight that the ABAK Tour could form a base for possible bicycle projects while determining its routes from the very beginning” (Online, ABAK, 31.07.2017).

In fact, the bicycle routes in the İzmir Peninsula project implemented by Izmir Metropolitan Municipality were created with reference to ABAK routes (Yarimadaizmir, 2023). This finding shows that although ABAK is an informal group, it plays an active role in developing destinations in cooperation with the local government.

In the case of Velesbid, Kızılınler Village, which is 13 km from the city centre, is often a stopover or arrival point for cycling activities due to the suitability of the terrain, low traffic and nature. The village has become a recreational destination with the demand for cyclists. Every year, Velesbid organises a "Pumpkin Tour" in the village of Kızılınler, which is famous for its pumpkins. The

volunteers decorate the village square, the villagers offer the cyclists the pumpkin dessert they have made and sell their homemade products. The event's Facebook statement reads as follows:

“We cyclists wanted to contribute to Kızılınler where we pedal for a long time in the hope of making the pumpkin value, a brand” (Online, Velesbid, 3.11.2017).

In addition, Velesbid has converted an unused farmhouse into the Velesbid Bicycle House with sections such as a guest house, camping area, hobby garden, workshop studio and activity hall (Figure 2a, 2f & 2g). National and international travellers can stay at the house free of charge (image 2c). Velesbid Bicycle House has become an important attraction for the town in terms of national bicycle tourism.

4.4. Economic Benefit

According to the observations, the tribes surveyed demand a certain participation fee or donation from the tourist events. This fee is used to cover tourist expenses such as food and drink, camping sites, or bicycle or bag transport. In the case of ABAK, the participation fee is calculated by dividing the total expenditure by the number of participants. A participant in the ABAK organising committee stated the following:

“We try to prioritize local values. We try to cooperate with local producers. For example, we purchase our meals from a family business that caters to village weddings.” (Observation, ABAK, 23.04.2017).

Figure 1d shows the local food provider and some volunteer participants serving food together. This result shows that a co-creation value process has occurred between service providers and participants.

Similarly, Velesbid provides services from tourism companies for the Eskisehir Bicycle Festival in camping and out-of-town tours. The organising committees buy food and drink, accommodation or transport services directly from service providers (e.g. bus company, restaurant) and prepare a package tour. As Velesbid is an association with fixed and variable costs, the participation fee includes the cost of the tour as well as donations.

This means that the tribes are economically active on a small and local scale. Thus, tribes can benefit economically from their events in order to continue their existence. They also generate economic benefits through purchases from the tourism industry.

4.4. Social Benefit

As a further result, the study found that cycling tribes create social benefits within the sub-themes of advocacy for cyclists' rights, social responsibility and participation. Accordingly, both tribes advocate for cyclists' rights in the name of social welfare. While Velesbid organises activities for the

development of bicycle lanes and raising awareness of cyclists in traffic, ABAK shares news and information about bicycle lanes on its Facebook page.

The tribes carry out various social responsibility projects that are either directly or indirectly related to their objectives. Firstly, in the case of ABAK, the tour is organised every year on 23 April, National Sovereignty and Children's Day. As part of the tour programme, this important day is celebrated with the children in a village along the route. For example, children in the village of Manisa Köselier were given bicycles during the 2015 ABAK tour (Figure 1b). Gifts are given to the children or activities are carried out to help them, such as painting their schools. Not only during the tour, but throughout the year, ABAK's social responsibility awareness continues with online communication throughout the year. Looking at the Facebook pages, there are many posts about the development of bicycle transport. They have also organised activities for children with autism. For example, one Facebook post reads as follows:

“On Wednesday, January 13, between 13.00-15.00, we started cycling and photography trainings for our autistic children, together with a group of volunteers with a big, willing and self-sacrificing heart.” (Online, ABAK, 13.01.2016)

As a non-governmental and formal organisation, Velesbid has more frequent and relatively organised activities for social benefit. The community participates in platforms and organises awareness-raising events for the development of cycling in the city. Co-pedal events are organised, i.e. cycling on tandem bicycles used by two people (sighted and visually impaired). To raise awareness on important days such as Violence against Women or International Day of Persons with Disabilities, social tours with broad participation are organised in the city (Figure 2e).

In addition to social responsibility, both tribes attach great importance to participation in their practices and discourses. For example, one member explains how they followed a democratic path in organising the ABAK tours:

“Before deciding on the gifts, samples were shown and we discussed which could be. Voting was held... We made our decision with the majority of votes... Food menus, banner design... such a process worked in all of them.” (Observation, ABAK, 23.04.2017).

Thus, tribes that expand their domains with social responsibility projects idealise the generation of social benefits. Similarly, they contribute to the development of a culture of democracy in society through the principle of participation.

5. CONCLUSION & DISCUSSION

Recreational communities as neo-tribes are receiving increasing attention in the hospitality and leisure literature (Hardy et al., 2018; Pforr et al., 2021). In general, neo-tribal research explains communities as consumption networks, starting from the idea of Maffesoli's (1996) heterogeneous

consumption patterns (Cova & Cova, 2001; Goulding et al., 2013; Hardy, 2021). Although some studies suggest that tribes have a co-creative nature (Canniford, 2011; Cova & Dalli, 2018), the production function of tribes as an entrepreneurial structure remains understudied. Based on the prosumer concept, which refers to the intertwining of production and consumption domains, the main objective of the current study was to investigate the production functions of recreational neo-tribes. As a result of the ethnographic study of the two cycling neo-tribes, the study concluded that the cycling neo-tribes have productive functions, including event organisation, experience development, destination development, economic benefits and social benefits.

Firstly, in terms of sectoral production, the tribes organise tourist and leisure events. According to the segments of bicycle tourism proposed by Lamont and Buultjens (2011, p. 60), the ABAK tour can be identified as a participatory event, defined as 'commercially organised, non-competitive events of one or more days; profit or charitable objectives'. Similarly, Velesbid organises recreational and participatory events based on this segmentation. Both non-commercial tribes have asked participants to pay a fee or make a donation to the events and activities they organise. The collected money was mainly used to cover the costs of food, accommodation and entertainment. As a result, cycling tribes combine different services and produce event services. This finding supports the literature on tourism and leisure tribes by showing that tribes organise events themselves (Bertella, 2018; Dolles et al., 2018; Vorobjovas-Pinta, 2018). Similarly, cycling festivals, which are an important part of the supply of cycling tourism in Türkiye, are mostly organised by cycling communities (Bisiklopedi, 2023). In addition to the fact that these activities are non-commercial as they are based on volunteer work, these activities fill a sectoral gap. Therefore, it was concluded that cycling neo-tribes could play the role of event producers from a sectoral perspective.

Secondly, the study concluded that members had a wide range of experiences of tribal interactions. Many of these experiences have been identified in studies of tourism and leisure tribes. For example, belonging (Robards, 2018), sharing similar values (Bertella, 2018; Vorobjovas-Pinta, 2018) or lifestyles (Bennett, 1999; Hardy et al., 2012) have been identified in previous studies. In this regard, leisure experiences emerge with the social interactions provided by the tribal atmosphere. Building on the findings supporting the literature, we take the discussion one step further. The results suggest that the group atmosphere not only creates experiences, but also promotes these experiences. For example, as ABAK states its purpose as 'to strengthen the love of history and nature through cycling culture' (ABAK Facebook page), it promises experiences such as enjoying nature, entertainment, learning and sharing similar values. Similarly, Velesbid's aim is to "support the cycling movement, which includes forms of transport, sport and leisure" (Velesbid Facebook page), and this promises experiences such as physical fitness, entertainment and physical rest. Studies focusing on tribal practices have shown that the tribe is represented through symbols and rituals (Hardy et al. 2013; Vorobjovas-Pinta & Lewis, 2021). Furthermore, tribal practices and their symbolic world are based on communal ethics (Cova and

Cova, 2001) or shared and negotiated norms and rules (Goulding et al., 2013). In this respect, tribal experiences can be seen as an individual reflection or outcome of tribal practices. Thus, experiences are not only created, but also encouraged and facilitated by tribal codes of ethics and norms. Consequently, we concluded that the neo-tribe is a corporate body that develops experiences collectively.

Thirdly, it was observed that cycling tribes have a destination development function. In both tribes, the routes and locations commonly used in touring programmes have developed over time into popular tourist or leisure destinations. Previous studies have examined the space and/or place production of tribal relationships (Canosa & Bennet, 2021; Hayday et al. 2021; Vorobjovas-Pinta & Lewis, 2021). In particular, the anchoring of places where tribal rituals are performed to develop a sense of belonging implies the tribe's place production function (Cova & Cova 2002; Lv & Qian 2018; Wang & Xie, 2021). In this regard, the study revealed that recreational cycling tribes serve to produce destinations and recreational areas that correspond to 'place' in the hospitality and leisure literature. For example, the Velesbid Bicycle House has become a destination in Eskisehir bicycle tourism through the interaction of tribe members and travellers. In addition, ABAK routes are now included in İzmir's tourism inventory (Yarimadaizmir, 2023). In addition, tribes are used to disseminate information about existing destinations and to create new cycling destinations. As a result, tribes are not only a demand for visiting an attraction, but can also serve as a supply partner in the creation and development of recreational areas and destinations.

Fourthly, the study concluded that tribes are involved in small and local economic activities. Tribes organise events by purchasing services such as transport, food and accommodation from hospitality businesses. In this way, tribes can have an economic impact on the tourism industry by assuming the role of retailers. At the same time, these activities are seen as co-creation value processes. Neo-tribes are by nature co-creative structures (Canniford, 2011; Cova & Dalli, 2018). Thus, tribes create an economic benefit based on co-creation for local and small businesses. On the other hand, prosumerism does not necessarily end in co-creation that requires a second party (Toffler, 1981; Cova & Dalli, 2018). Events can be organised through interactions between members and sometimes even without the need to purchase from a service provider company (Sykes, 2021). The results of this study show that tribes can carry out some of their activities without a second actor or purchase. Furthermore, one of the tribes (Velesbid) sustains itself by covering its expenses with the income it earns from the events. Therefore, the tribal events are not for commercial purposes, but provide direct economic benefits to the tribes.

Finally, the study concluded that cycling tribes generate social benefits in terms of promoting participation in society and social responsibility. Previous studies draw attention to the social aspect of tribes on various issues such as social well-being (Moutinho et al., 2007; Cova and Dalli, 2018), representation of social identities (Vorobjovas-Pinta, 2018; Sykes, 2021), and contested spaces against hegemony (Hayday et al., 2021; Hughson, 1999). This study also showed that members with a cycling

identity defended their rights in the public space provided by the tribes. Furthermore, cycling tribes can act with social responsibility in matters not directly related to their purpose of existence. In addition, the development of democratic culture is vital in developing countries with over-centralised administration, including Türkiye (Tosun, 2000). Therefore, cycling tribes that act according to the principle of participation contribute to the development of the culture of democracy, which is an important social benefit.

6. IMPLICATIONS & LIMITATIONS

6.1. Theoretical Implications

Neo-tribal studies provide a powerful theoretical framework for understanding communal leisure behaviour and individual behaviour within groups. In this respect, this study has made three main contributions to the leisure and neo-tribal literature. First, the study has opened up discussion about the assumption that neo-tribes are consumer-based structures. Typically, neo-tribes are seen as consumption networks that form around experiences (Cova & Cova 2002; Kozinets, 1999; Hardy, 2021). On the other hand, this study shows that neo-tribes have production functions in sectoral (event organisation, experience development, destination development) and social terms (economic and social benefits).

Secondly, the study presents the suggestion that neo-tribes can be defined as prosumers, based on the cycling tribes studied. Although there are studies that talk about the co-creative nature of neo-tribes (Canniford, 2011; Cova & Dalli, 2018), this study is the first to investigate prosumer tribes with empirical evidence. In both tribes studied, there are examples of co-creation in collaboration with hospitality companies, as well as productive actions in the form of developing experiences, events or destinations without a producer role. By revealing the productive functions of tribes, the study suggests that they can be recognised as prosumers

6.2. Practical Implications

The findings of the study have important implications for both hospitality businesses and policy makers. Firstly, neo-tribes, with their prosumer identities, are both a target group and a business partner for hospitality and leisure stakeholders. In this respect, tribes should be supported to organise events that generate economic and social benefits. The destination development capacities of locally influential neo-tribes can be utilised. In addition, as tribes are based on volunteerism, many destination applications can be carried out in cooperation with tribes.

The fact that cycling tribes organise their own events may at first appear to be a threat to the hospitality industry (especially tour operators and travel agents). According to Toffler (1981), the increasing prosumerism may lead to the self-sufficiency of consumers and thus to the end of the market for goods and services. For cycling tourism in Türkiye, the organisers of cycling events are usually associations, sports clubs and cycling groups (Bisiklopedi, 2023). For Türkiye, the number of agencies operating in this market is still very limited. Therefore, cycling tribes are more of a market opportunity

for agencies than a threat. Tribes allow tourism and leisure companies to be aware of new markets. In addition, the knowledge of the market is hidden in the tribes as a constituent element of this market. Companies specialised in cycling activities should play a facilitating role for tribes and enable tribes to self-fulfil the prosumer process. Considering the low economic contribution of cycling tribes, especially at the local level, agencies should not expect high profits from this market segment. In this respect, companies should aim for social sustainability rather than profitability. Developing relationships with tribes will create a very good cross-selling opportunity for companies. Due to the network structural characteristics of tribes, it is recommended that businesses use relational marketing methods.

All types of leisure activities in the form of recreation or tourism provide individual contributions such as well-being, self-renewal and fulfilment. In this respect, cycling neo-tribes also create alternative living spaces that give meaning to individuals' existence and increase their quality of life. Individuals feel happier by developing a sense of belonging and trust within tribes. The results of the study show that tribes also create value in terms of social welfare by generating social benefits and serving the developing community. Therefore, supporting and encouraging prosumer tribes, which are among the most important actors for sustainability, can also have a positive impact on social welfare.

6.3. Limitations & Future Research

The study is limited to the cycling communities studied. The study focused on exploring only the productive functions of tribes, as the literature already agrees on their consumer functions. Future studies investigating tribes in different sectors will strengthen the conceptualisation of prosumer tribes by investigating producer and consumer functions together. Furthermore, the sectoral functions of tribes in this study were limited to the hospitality sector. Expenditures by members, such as cycling equipment and clothing, can also be estimated to have indirect impacts in relevant sectors. Future studies should therefore also consider the indirect economic impact of tribes.

This study focuses on the face-to-face production of the tribes studied. Although social media data is also used, online content produced by these tribes (e.g. route information, destination reviews, etc.) is excluded from the scope of the study. The role of cycling prosumer tribes as online content producers can be investigated. Finally, the results of the study offer a positive interpretation of tribes as prosumers. The question of whether exploitative capitalist prosumerism applies to entertainment communities remains to be answered.

The study does not necessitate Ethics Committee permission.

The study has been crafted in adherence to the principles of research and publication ethics.

The authors declare that there exists no financial conflict of interest involving any institution, organization, or individual(s) associated with the article. Furthermore, there are no conflicts of interest among the authors themselves.

Contribution: Kübra Aşan: Conceptualization, Methodology, Writing – original draft. Medet Yolal: Conceptualization, Supervision.

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Comparison of Studies Conducted in the Field of Neuromarketing and Artificial Intelligence Using Bibliometric Method

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Abstract

Neuromarketing research focuses on consumer purchase intention, decision-making processes, purchase behavior, brand awareness, brand loyalty, and repeat purchase behavior. In these studies, consumer behavior has been analyzed using neuroscientific methods and tools. The most commonly used tools include Functional Magnetic Resonance Imaging (fMRI), Eye Tracking, Electroencephalogram (EEG), Positron Emission Tomography (PET), Transcranial Magnetic Stimulation (TMS), Magnetoencephalogram (MEG), Steady State Topography (SST), Implicit Association Test (IAT), Facial Electromyography (fEMG), Automatic Face Coding (AFC), Skin Conductance Response (SCR), and other methods for measuring physiological responses. However, the use of these neuroscientific tools is not always possible due to economic constraints and lack of experimental design. Neuroscientific imaging and measurement methods are not preferred in every study due to their high costs and expertise requirements. However, when neuromarketing studies are examined, it is seen that methods such as Eye Tracking, EEG and fMRI are used more widely. These tools contribute to a deeper understanding of consumer behavior. In order to better analyze consumer behavior, it is of great importance to convey marketing stimuli and messages correctly. In the field of marketing, the effect of stimuli conveyed to consumers using the five senses is one of the focal points of neuromarketing. More than one neuroscientific method should be used together to understand consumer intentions, thoughts and purchasing behaviors. In this way, the obtained data can be analyzed more comprehensively and clearer insights can be provided about neuromarketing. The aim of this study is to present a comprehensive assessment of the use of neuroscientific tools by examining the publications in the field of neuromarketing in the Web of Science database between 2010-2024 with bibliometric analysis. The study will address the limitations of not using more than one neuroscientific tool together in neuromarketing research and the inadequacy of analyses supported by artificial intelligence. A more holistic approach will be proposed to address these shortcomings and a guiding resource for future research will be created.

Keywords: *Neuromarketing, Neuroscientific Tools, Artificial Intelligence*



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1. INTRODUCTION

The marketing discipline is changing significantly by expanding concepts, theories, and methods derived from disciplines such as psychology, sociology, anthropology, and neuroscience and adapting to the multidimensional view of consumer preferences. Emotions, biases and values are becoming increasingly important as internal factors for understanding consumers' preferences (Stas et al., 2018). Considering that 95% of purchasing decisions are made through the subconscious, it is an undeniable fact that different tools and methods are needed to better understand the subconscious (Mouline, 2019). In the current era of intense competition, a minor degree of anticipation is pivotal for companies to enhance the efficiency of fresh product launches and promotional messaging. While conventional consumer research methods such as surveys and focus groups play a role, they pose the challenge that consumers may not consistently be capable or inclined to furnish essential information. Consequently, marketing researchers have endeavored to address these limitations by delving into the consumer's subconscious (e.g., via motivational exploration and projective methodologies) and scrutinizing their decision-making processes for extended periods. However, these efforts have been partially successful in helping to understand consumers (Wilson et al., 2008; Conejo et al., 2007). Information is obtained using neuroscientific theories and methods to access the consumer's unconscious information, and this information is obtained through observation of neural processes without directly asking people about their thoughts, feelings, memories, evaluations or decision-making strategies. Neuromarketing paves the way for creating new marketing theories or supporting existing theories in marketing and related disciplines (Bhandari, 2020).

It is a known fact among marketers from the past that consumers' attitudes towards a product, brand or advertisement are shaped not only by rational thoughts but also by emotions. When trying to measure consumer emotions in traditional marketing research methods, data is obtained only from external expressions and evaluations about consumer emotions are made with these data (Galandi et al., 2022). While consumers today are exposed to thousands of marketing messages, this number is rapidly increasing as marketers offer more and more stimuli to reach consumers. Attracting the attention of consumers, whose attention is divided across different channels and multiple tasks with messages, has therefore become more difficult than ever for marketers (Saxon, 2017). What motivates individuals to purchase specific products or services? This inquiry stands at the core of every marketing and advertising professional's considerations, giving rise to the emergence of a burgeoning industry: Market research. Traditionally, market research has leaned on data gathered from consumers through diverse methods like surveys, focus groups, and interviews. Neuromarketing, on the other hand, employs biometrics, brain imaging, and various technologies to measure brain activity, capturing consumers' reactions to marketing stimuli. It involves leveraging neuroscience and physiological research techniques to comprehend consumer behaviors, preferences, decision-making processes, and other facets of human cognition relevant to marketing-related conduct. Thus, it provides access to much more

real and accurate data that cannot be obtained with traditional marketing methods (Brenninkmeijer et al., 2020; Sebastian, 2014; Stanton et al., 2017). In 2023, on a global scale, the USA and Canada spent 311.1 billion dollars, Asia Pacific Countries 241.5 billion dollars, Western Europe 135.2 billion dollars, Latin America 23.8 billion dollars, the Middle East and Africa 8.9 billion dollars, Central Europe 7.5 billion dollars on advertising expenses (Statista, 2024). According to research conducted in the field of neuromarketing; 3% of objects are perceived by tasting, 3% by touch, 3% by smell, 13% by hearing, 78% by sight, and the consumer makes a significant choice within 9 seconds. People learn 1% of what they learn by experiencing, 2% by touching, 4% by smelling, 10% by hearing, and 83% by observing the events around them (Clifton, 2014). Studies have shown that most advertising expenditures made with large budgets do not create the desired effect on the consumer. Therefore, studies to be conducted in the field of neuromarketing are of great importance for marketing researchers and businesses. However, it is understood that the neuroscientific method tools used in neuromarketing are not used sufficiently. Therefore, in this study, a bibliometric analysis will be conducted by scanning the studies published in the Web of Science database between 2010-2024 in terms of the tools used and artificial intelligence applications on neuromarketing. When the studies in the literature are examined, it is seen that there are deficiencies in the use of tools and methods to adequately understand some consumer behaviors and processes. It is understood that especially in studies conducted in the field of neuromarketing, one or two of some neuroscientific tools (eye tracking, face coding, galvanic skin conductance, heartbeat, electroencephalography, etc.) are used together and this situation leads to deficiencies in understanding and evaluating the reactions of consumer behavior to marketing messages transmitted through the five basic senses. In addition, considering the size of the data obtained in the studies (EEG data, eye tracking data, GSR data, face coding data, heart rhythm data, etc.), it is quite difficult for researchers to reach a healthy conclusion by examining such a large amount of data one by one. The fact that the number of studies conducted in the field of neuromarketing using more than one neuroscientific tool is quite limited and that artificial intelligence, machine learning and deep learning applications are used in a very limited number of studies reveals the importance of the research. The aim of this study is to compare the studies conducted in the field of neuromarketing and the findings obtained with neuroscientific tools. In addition, it is aimed to contribute to the determination of central tendencies with thematic analysis of the techniques used in cumulative information in related studies and to shed light on future research. In addition, it is aimed that the techniques used in cumulative information in relevant studies will contribute to the determination of central tendencies with thematic analysis and shed light on future research. In order to make a comparison within the scope of the research, two data sets were obtained from the most cited studies and those related only to neuromarketing. In this context, in the studies conducted in the Web of Science database, first the data belonging to the studies conducted in the field were obtained (using filters) with the keyword “neuromarketing”. Then, the second data set was obtained using the keywords “neuromarketing”, “neuroscientific tools” and “artificial intelligence”. Both data sets were obtained from 50

(neuromarketing keyword) and 41 studies (neuromarketing, neuroscientific tools and artificial intelligence keywords) conducted between 2010-2024 and analyzed separately with the R program and biblioshiny package program. The study, which explains what needs to be done in the context of understanding the deficiencies in the studies conducted in the literature and developing more holistic solution suggestions, will be a source for future research. In this context, the study will first discuss neuromarketing, neuroscientific tools used in neuromarketing, and the conceptual framework related to artificial intelligence. Then, studies on neuromarketing and artificial intelligence in the literature will be included and the research method will be discussed by referring to the data used. In the fifth section, the analysis of the obtained data and the findings will be discussed. In the last section, the results and limitations of the research are included.

2. CONCEPTUAL FRAMEWORK

Consumer purchase intention, decision making and purchasing behavior processes are shaped by many variables such as the consumer's desires, needs, expectations, past experiences, experiences, emotions, the environment they are in and the stimuli they are exposed to. Therefore, neuroscientific tools and methods used in neuromarketing are used to better understand consumer behavior. In this context, there is a need to explain the concepts of neuromarketing, neuroscientific tools, machine learning, deep learning and artificial intelligence used to analyze the data obtained from research more accurately.

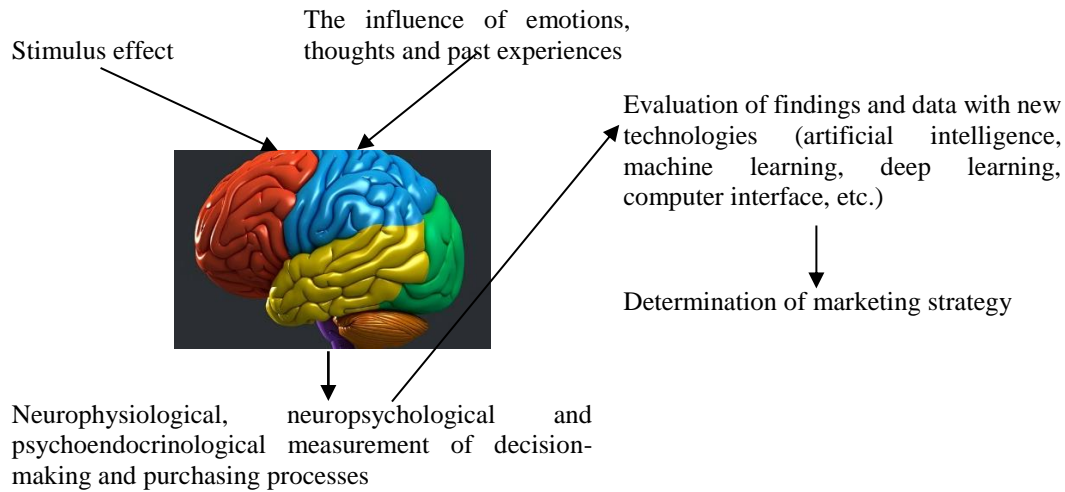
2.1. Neuromarketing

The term neuromarketing was created by combining the concepts of neuroscience and marketing, which are two different fields (Bhandari, 2020). Neuromarketing stands as a youthful domain within marketing, dedicated to unraveling how consumers react to various marketing stimuli. Coined by the amalgamation of neuroscience and marketing, the term "Neuromarketing" denotes the application of neuroscientific principles within the marketing realm (Yasir & Haq, 2022). The concept was first put forward by Ale Smidts. It is based on the principle of using neuroscience to analyze consumer behavior. Neuromarketing, which uses many different branches of science, especially psychology, in experimental research and studies, is considered to be the intersection of different sciences (Cosic, 2016; Burgos-Campero & Vargas-Hernandez, 2013; de Oliveira & Giraldo, 2017; Cárdenas, 2019). Consumer behaviors vary greatly in digital marketing, where classical methods and approaches are inadequate. For this reason, it is very difficult to obtain and evaluate simultaneous information about consumer emotions, thoughts and decision-making processes, which are a dynamic process. Neuroscience provides very useful information at this point (Brennkmeijer et al., 2020; Sebastian, 2014; Stanton et al., 2017). Obtaining some key information in consumer purchasing behavior and decision-making processes is of vital importance. Classical approaches are sometimes insufficient in obtaining this information. At this point, neuroscientific methods and tools come to the rescue of marketing science. In this way, the neurophysiological and neuropsychological responses of individuals are better understood. This

facilitates the creation of different and successful strategies. Most importantly, it is measurable, transparent and comparable (Binodl & Jothi 2020; Meckl-Sloan, 2015). This new discipline is a successful result of the collaboration between economics, psychology and neuroscience. Fundamentally, it is possible to better understand human behavior and its underlying causes (Kumar, 2015). The ultimate goal of this method is to obtain results by using multiple tools, equipment, methods and approaches to better understand the results caused by many different parameters. Therefore, it focuses on a wide range of reasons underlying pre- and post-purchase consumer behavior (Nemorin & Gandy Jr., 2017, p. Senior & Lee, 2008; Fortunato et al., 2014). Neuromarketing consists of the fields of social and experimental psychology, econometrics, neuroscience and economics. Neuromarketing can be defined as a subfield of neuroeconomics in which the application of neuroscientific methods to analyze and understand human behavior in relation to markets and market changes is increasing. Neuromarketing is a new branch of marketing that uses neuroscience to determine a consumer's subconscious response to products and brands in order to create effective marketing strategies (Shukla, 2019). Thanks to the opportunities provided by neuroscience to marketing science, it is possible to evaluate consumer behavior from a different and holistic perspective and make correct inferences. It is possible to understand what kind of manipulations are caused in the consumer mind and behavior by messages intended to be conveyed through marketing stimuli (advertisement, sound, music, color, packaging, etc.). Thus, it becomes easier to develop and implement more effective strategies regarding consumer pre-purchase decision-making processes. In studies conducted in the field of neuromarketing, the effects of marketing stimuli (advertisement, brand, packaging, logo, color, etc.) on consumer behavior and preferences have been addressed from neurophysiological and neuropsychological perspectives. The impact of psychoneuroendocrinology on emotions, thoughts and decision-making has been neglected. Psychoneuroendocrinology allows understanding of the impact of hormones and body chemicals on behavior and decision-making processes. Psychoneuroendocrinology encompasses the integral structural and functional relationships between hormonal systems and the Central Nervous System and the behaviors that modulate and derive from both. Hormones have a great impact on human emotions, thoughts, behavior and decision-making processes. Hormones are secreted as a result of stimulation of the brain and have a great impact on behavior. For example, when a consumer buys a product that may be an opportunity for him/her, a perception of reward occurs in the brain and dopamine is secreted intensely. Songur, (2022) states that areas such as the ventral tegmental area, basal nuclei, prefrontal cortex, insular cortex, limbic system (areas such as hippocampus and amygdala), accumbens nucleus, thalamus and hypothalamus have an important place in the reward system. It is known that hormones and brain messenger chemicals (neurotransmitters) are secreted when these reward areas are activated in case of reward perception, gain or loss concern, and economic decisions in consumer decision-making and purchasing processes. Because these are the premises for behavior and decision-making. This is why the neuropsychoneuroendocrinological approach is important in the field of neuromarketing. In this context, neuromarketing is very important to address consumer thought, decision-making and behavior

processes neurophysiologically, neuropsychologically and psychoneuroendocrinologically with neuroscientific methods and tools.

Figure 1. Neuromarketing Process

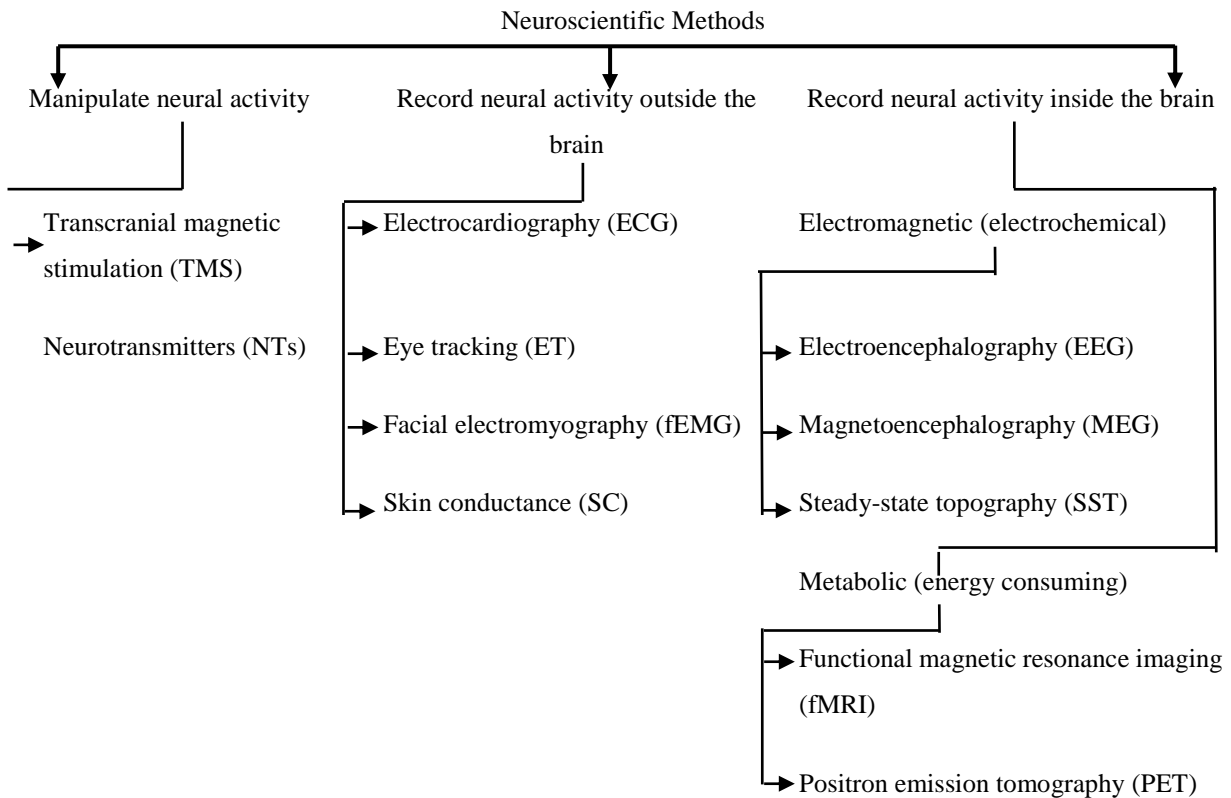


Source: Created by the author

2.2. Neuroscientific Tools Used in Neuromarketing

Neuroscientific investigations hinge on three fundamental components: Location, connectivity, and representation. Location signifies the specific brain areas capable of detecting heightened stimuli, such as the superior colliculus, hypothalamus, or amygdala. Connectivity involves the intricate network of connections between neurons across different brain regions to process information. Representation entails the scrutiny of how information is coded in the brain (Grajdieru, 2017). The arsenal of neuromarketing techniques commonly employed for the analysis of human behavior includes functional magnetic resonance imaging (fMRI), electroencephalography (EEG), eye-tracking glasses, magnetoencephalography (MEG), and positron emission tomography (PET). However, neuromarketing involves more than brain activity and measurements. As an alternative to brain imaging, researchers can measure heart rate, respiration, skin conductance (hand sweat), eye tracking (recording exactly what the eyes are looking at), aspects of environmental physiology, and more, and then relate these measurements to consumers' experiences (Stanton et al., 2017, p. 2). Tools and methods in neuromarketing research are based on three basic principles. Measurements based on the neural metabolic activity of the brain, measurements based on electrical activity, and measurements based on physical activity other than brain activity. It is shown in Figure 2.

Figure 2. Tools and Methods Used in Neuromarketing



Source: (Lim, 2018)

The concept of neuromarketing was first introduced by Professor at Harvard University in the second half of 1990. It came to the fore when Gerry Zaltman announced that he was using the functional magnetic resonance device (fMRI) in marketing research. It was Prof. who expressed these studies with the concept of neuromarketing in 2002. Ale Smidts (Ural, 2008). The tools and methods used in neuromarketing research vary depending on the study. However, the most commonly used tools are Eye Tracking (ET), Electroencephalography (EEG), and Functional magnetic resonance imaging (fMRI).

Table 1. Neuromarketing Tools

Tool or Methods	Working Principle	Features	Shortcomings
Functional magnetic resonance imaging (fMRI)	The neuroimaging approach gauges the quantity of oxygenated hemoglobin correlated with neuronal activity, providing insight into cerebral function through superior temporal and spatial resolution. Detection of the blood oxygenation level-dependent (BOLD) signal is executed utilizing magnetic resonance imaging (MRI) scanning techniques	<ul style="list-style-type: none"> • Observing cerebral activities with elevated temporal and spatial precision • Precise identification of neural activity associated with alterations in cognitive and emotional states • Being non-invasive • Detailed neuroimaging • High reliability 	<ul style="list-style-type: none"> • High costs • Difficulty in transportation and installation • Difficulty in analyzing data and inability to scale

Electro-encephalogram (EEG)	<p>The technique quantifies alterations in cortical electrical activity, capturing and registering distinct electroencephalographic (EEG) waveforms associated with specific cognitive states such as relaxation (alpha waves), alertness (beta waves), sleep (delta waves), and tranquility (theta waves)</p>	<ul style="list-style-type: none"> • Being easily portable • High temporal resolution • Being economical • Finding new devices with Wi-Fi technology • Ease of data processing with computer interface programs • Monitoring electrical activity related to neural response • Measuring the effect of emotional stimulation 	<ul style="list-style-type: none"> • Lack of spatial resolution • Inability to monitor differences within deep brain structures • High sound level • Inability to distinguish neural activity occurring in reward centers such as Hippocampus, Amygdala, Hypothalamus, Hippocampus • Erroneous measurements caused by participants
Eye Tracking (ET)	<p>The methodology operates on the foundational principle of acquiring measurements through the generation of thermal maps indicative of physiological activity. This includes the dynamic analysis of pupil dilation and constriction in response to ocular movements, the assessment of gaze fixation frequency, and the identification of multiple points under scrutiny</p>	<ul style="list-style-type: none"> • Lower costs • No contact with the participant • Ease of measurement • Portability • Ease of data processing with computer interface programs 	<ul style="list-style-type: none"> • Need for calibration with every measurement • Measurement takes time and participant attention decreases • Cost of ET device
Positron Emission Tomography (PET)	<p>The foundation of this approach lies in the principle of generating visual mappings that delineate regions characterized by heightened blood flow, contingent upon the intensity of metabolic activity associated with glucose consumption. This methodology unveils neuropsychological indices that underlie neural activity</p>	<ul style="list-style-type: none"> • High spatial resolution • Revealing the neurophysiological background of neurocognitive activity • Deep and detailed analysis with radioactivity • Three-dimensional viewing opportunity 	<ul style="list-style-type: none"> • High costs • Usage restriction due to radiation hazard • Limited temporal resolution
Facial Electromyography (fEMG)	<p>The methodology is grounded in the principle of quantifying electrical activity emanating from contractions arising from the individual and synergistic movements of diverse muscle groups</p>	<ul style="list-style-type: none"> • Understanding emotional state • Detection of different muscle activities • High reliability due to muscle movements • Non-invasive ease of use 	<ul style="list-style-type: none"> • Similar muscles move in some emotions • Difficulty distinguishing some emotions
Magneto-encephalography (MEG)	<p>The foundation of this approach relies on the measurement of electromagnetic fields generated by the formation of action potentials</p>	<ul style="list-style-type: none"> • Being non-invasive • High sensitivity and spatial resolution • Easy to use 	<ul style="list-style-type: none"> • High costs • Difficult to install and move • Measures only based on brain neural activity
Automatic Face Coding (AFC)	<p>The methodology is founded on the principle of recording the fundamental emotional state and moment-to-moment fluctuations, subsequently categorizing them through the utilization of a devised face mapping technique. Emotional states are discerned based on the coordinated or distinct movements of 43 specific muscle groups</p>	<ul style="list-style-type: none"> • Simple and practical to use • Ability to create mood patterns based on facial movements • Prediction of certain emotions and feelings with high accuracy 	<ul style="list-style-type: none"> • The data obtained are debatable • Requires software • Difficulty processing instant data

<p>Skin Conductance Response (SCR)</p>	<p>The methodology is grounded in the principle of recording data derived from the functioning of sweat glands, reflective of immediate alterations in electrodermal activity</p>	<ul style="list-style-type: none"> • Measurement of electrodermal activity according to momentary mood change • Ease of mobile use • Lower costs • Participant's ability to move during measurement 	<ul style="list-style-type: none"> • Measurement may be affected by ambient temperature and humidity • Temporal differences between action, reaction and report processes
<p>Implicit Association Test (IAT)</p>	<p>The approach is rooted in comprehending implicit attitudes through the elicitation of specific concepts and expressions related to psychological, social attitudes, and behaviors. It constitutes a psychometric instrument engineered to gauge the robustness of automatic associations between mental representations of objects and concepts The lag in response time signifies a frail connection between the selected term and the group within the participant, while a reduction in reaction time indicates a robust bond. Swiftly associating words with negative connotations with a specific social group implies the existence of implicit bias</p>	<ul style="list-style-type: none"> • Implicit tests allow assessment of attitude/cognition without requiring people to deliberately consider their responses with insight. • Applicability via mobile devices • A deeper understanding of the participant's stance on a topic 	<ul style="list-style-type: none"> • Difficulty distinguishing different emotions from the object being evaluated • The effectiveness of prejudices
<p>Steady State Topography (SST)</p>	<p>Visual evoked potentials, discerned within the subject's electroencephalogram (EEG) activity when exposed to visual stimuli, particularly in the context of marketing stimuli, gauge variations in Steady State Topography This approach ensures a commendable temporal resolution by persistently monitoring these cerebral activity shifts across prolonged intervals, showcasing a heightened resilience to extraneous interference. However, the applicability of such instruments is confined to visual stimuli, and their deployment may be characterized as somewhat obtrusive to study participants</p>	<ul style="list-style-type: none"> •High temporal resolution •High data quality •Lower costs •Ease of Use 	<ul style="list-style-type: none"> •Limited coordination of movements between two tasks •Low spatial resolution
<p>Electro-cardiogram (ECG)</p>	<p>The methodology is grounded in the principle of documenting alterations in heart rhythm induced by the autonomic nervous system's involuntary responses orchestrated by the brain. This intricate system, involving both the sympathetic and parasympathetic branches, reacts to diverse stimuli, capturing nuanced physiological reactions</p>	<ul style="list-style-type: none"> •Lower costs •High data quality •Ease of Use •Portability •Understanding the participant's response to stimuli 	<ul style="list-style-type: none"> •The testing process takes time

Source: Created by the author

2.3. Machine Learning, Deep Learning and Artificial Intelligence

Machine learning has an important place as a sub-branch of artificial intelligence and stands out with its ability to make predictions about the future with data-based learning processes. Studies in this field primarily focus on developing models that can predict future events or situations by learning from past data. Machine learning methods perform the learning process by examining complex relationships between data attributes and extracting meaningful patterns from these relationships. These algorithms usually draw attention with their capacity to extract information by performing in-depth analysis on

multidimensional data sets and without depending on predetermined conditions (Abbott, 2014). Machine learning, which is based on creating mathematical models by associating the most meaningful and appropriate features within existing data within a certain algorithm, aims to reveal the relationships between data correctly (Kelleher, 2019, p. 11). Thanks to the mathematical models produced, complex structures become simple, plain and understandable. It is almost impossible to analyze very large and voluminous data manually by human hands. For this reason, it analyzes relationships based on the learning model using implicit patterns in data sets. Selecting the most appropriate model and optimizing it according to features constitutes the basis of machine learning.

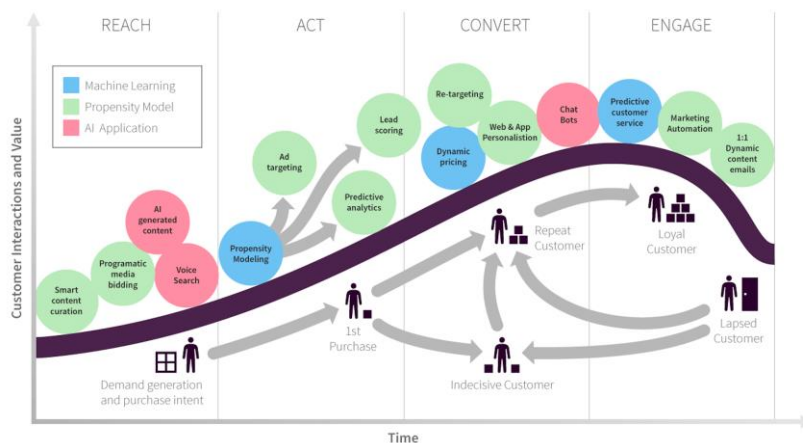
Machine learning is about the ability to generalize data and apply this information to new and unknown data. Algorithms can make predictions about future data points by learning from past experiences and using the information obtained from these experiences. It can reveal even the most complex relationships by making an evaluation from the specific to the general thanks to the mathematical models it has developed by starting from the hidden patterns in the large data set. It has an understanding that works with inductive logic especially in the fields where there is a lot of data and this data needs to be processed and information is obtained (medicine, psychology, economics, social sciences, health, space research etc.). The field, which is constantly developing, is accepted as a branch of artificial intelligence. It has the ability to reveal even the most mysterious relationships and even to prove their accuracy by testing them thanks to artificial neural networks. It is widely used thanks to the multi-layered structures in the data set, complex learning algorithms, and natural language processing feature. It offers important contributions in many different fields thanks to its ability to draw meaningful conclusions from structures called big data (LeCun et al., 2015, p. Schmidhuber, 2015).

Machine learning and deep learning have different abilities in terms of certain specific features. While making high-accuracy predictions by processing and generalizing data is the basis of machine learning, structuring complex data sets by analyzing them is the basis of deep learning. This situation makes it possible for large and complex data to become much easier, understandable and analyzable thanks to deep learning. In short, deep learning is a sub-unit of artificial intelligence that tries to obtain the whole from the data by simulating large data sets in the form of structures similar to artificial neural networks. Thanks to this feature, it becomes easier to solve problems that are difficult to solve or require a lot of time in many different fields and disciplines. Deep learning, which produces effective results in various application areas such as speech and visual recognition, has the capacity to perform deeper and more complex data analysis and to derive meaningful results from this data, unlike machine learning. Deep learning has an important place in artificial intelligence research with these aspects and is used in various scientific and industrial fields.

Artificial intelligence is considered a broad concept that mimics human cognitive processes and includes learning and problem-solving abilities (IBM Think Blog, 2017). This technology finds a wide

range of applications, including optimization principles. The first artificial intelligence project proposed by John McCarthy and his team in 1955 (McCarthy et al., 1955) led to theoretical inferences that the use of artificial intelligence in analytical tasks could reduce the need for intuitive and empathic skills (Huang & Rust, 2018, p. 155). Rapid advances in artificial intelligence also offer innovative and exciting opportunities in marketing science. Examining the current knowledge of this field and identifying research gaps are critical to increasing the efficiency of potential studies (Wirtz, 2021, p. 1). Artificial intelligence is used in the field of marketing to examine interactions with market participants and change the definition of these participants. While actors are traditionally defined in sociology and social psychology as individuals who take conscious actions in their own worlds, artificial intelligence in the business world offers a new approach that challenges traditional interaction models (Håkansson et al., 2009). While marketing experts evaluate artificial intelligence as a time-saving tool for achieving strategic goals, they also see it as a threat to the workforce (van Esch & Black, 2021, p. 199). The impact of artificial intelligence technologies on social and relational dynamics from a marketing perspective is striking. In particular, significant gains can be achieved in the field of marketing thanks to the combined use of machine learning or artificial intelligence. For this reason, it is evaluated that both technologies can make significant contributions to almost every stage of marketing activities. The model developed by Smart Insight on this subject is shown in Figure 3.

Figure 3. Artificial Intelligence Applications Used in Marketing



Source: Smart Insights, n.d.

It is important that how artificial intelligence transforms the structure of business networks and that these processes have not been discussed enough (LaPlaca & Lindgreen, 2016). Artificial intelligence is considered the pinnacle of science based on the aim of creating machines with human-like thinking capacity (McCorduck, 1982, p. 242). Artificial intelligence, which has become widespread in many fields by gaining strength in the twenty-first century, has become a trend in various sectors such as science, business and medicine and has also shown itself in marketing (Jarek & Mazurek, 2019, p. 46). In the field of marketing, it offers innovations in many areas such as content creation, customer

acquisition, cost reduction and customer experience management in conceptualization, theory and research processes. Artificial intelligence is used by various brands to fulfill marketing functions from digital advertisements to practical applications (van Esch & Stewart Black, 2021, p. 199). Digital and artificial intelligence technologies are transforming industries based on the idea of creating machines that exhibit superior performance in areas such as speech, understanding and language translation (Elia et al., 2020, p. 1). Marketing science and competition are also affected by this change. When evaluated in terms of business models and marketing, businesses equipped with artificial intelligence technology gain competitive advantage, while those that do not use this technology are at a disadvantage. Therefore, the innovations created by artificial intelligence technologies in the field of marketing offer significant advantages in the global competitive environment (Lee et al., 2019, p. 1). The rapid spread of artificial intelligence-based applications and marketing innovations in business life and industrial marketing requires the evaluation of existing research with qualitative and quantitative approaches (Kumar et al., 2020, p. 126; Han et al., 2021, p. 2467). It is expected that artificial intelligence will continue to be used in marketing functions (Mustak et al., 2021, p. 390). This holistic perspective can increase the power of marketing (Haenlein & Kaplan, 2019, p. 5).

3. LITERATURE REVIEW

Recent neuroscientific developments regarding the structure and functioning of the brain have also revealed new ways to understand the consumer and neuromarketing. This new field of knowledge is gradually becoming an essential complement to marketing research (Duque-Hurtado et al., 2020). Today, the widespread use of neuromarketing techniques to evaluate customer preferences and decision-making processes is advantageous for customers and marketers. Considering that more than 90% of information is processed subconsciously in the human brain, the reality of neuromarketing research reveals better results than traditional analysis methods based on surveys and interviews (Singh, 2020). Neuromarketing attempts to understand consumer attitudes and behaviors and the reasons behind them in a way that is aimed at measuring them. In the meantime, it is aimed to reach a generalization by measuring the reactions of the consumer to stimuli with neuroscientific tools. In this way, it is possible to create the most accurate and realistic marketing strategies and approaches possible (Rawnaque et al., 2020). According to Thomas et al., (2017), neuromarketing guides marketing managers by examining the reactions of people to events and situations. In this way, it is possible to make healthy inferences about the attitudes and approaches that consumers will adopt in the face of various situations (marketing stimuli effect) in the future (Lee et al., 2007). Researchers who want to turn this situation into an opportunity obtain much more realistic results by processing neuroscientific tools and the data they obtain from them with artificial intelligence-based applications. In this context, the studies conducted in the field and the findings obtained are given in Table 2.

Table 2. Studies and Findings in The Field of Neuromarketing and Artificial Intelligence

Writer(s)	Findings
Bowen, (2009)	The effectiveness of artificial intelligence in the process of document analysis, examination, evaluation and collection of certain data from existing documents in printed and electronic media
Ohme, Reykowska, Wiener & Choromanska, (2010)	Electrodermal activity data is proficient in discerning both approach and withdrawal reactions with effectiveness
Ariely & Berns, (2010)	Neuromarketing holds the potential to be more cost-effective than conventional methods and can unveil valuable insights throughout the product design phase
Maxwell, Jeffrey, & Lévesque, (2011)	Artificial intelligence and machine learning algorithms have enabled efficient data processing that allows formulating the right decision
Lajante, Droulers, Dondaine & Amarantini, (2012)	The fundamental emotional processes experienced by consumers, such as the evaluation of stimuli, can be precisely quantified through the recording and processing of electrodermal activity data
Khushaba, Greenacre, Kodagoda, Louviere, Burke & Dissanayake, (2012)	Integration of eye tracking and electroencephalography (EEG) data facilitates the discrimination of crucial factors during the product selection process
Gangadharbatla, Bradley & Wise, (2013)	The analysis of electrocardiogram (ECG) and electrodermal activity data implies that in-game advertisements could be indirectly retained in memory and exert an influence on subsequent decision-making processes
Somervuori & Ravaja, (2013)	Examination of electromyography (EMG) and electrodermal activity data revealed that lower prices and brand-name products elicited a 25% increase in positive emotional responses, accompanied by heightened purchase intent, in comparison to higher prices and private-label products
Maxian Bradley, Wise & Toulouse, (2013)	Electromyography (EMG) responses have demonstrated greater amplitude and positivity in reaction to well-liked brands, contrasting with increased amplitude and negativity observed in response to less favored brands
Fortunato, Giraldi & Oliveira, (2014)	Neuromarketing proves instrumental in unraveling intricate purchasing behaviors, offering insights into the degree of rationality entwined within consumer decision-making processes
Venkatraman, Dimoka, Pavlou, Vo, Hampton, Bollinger & Winer (2015)	Functional Magnetic Resonance Imaging (fMRI) holds a heightened capacity to predict distinctions in sales responses to advertising when juxtaposed with data derived from consumers' self-reported responses
Gupta & Falk, (2016)	Broadly speaking, our investigation indicates that graph-theoretic features derived from electroencephalogram (EEG) data are more adept at emotion classification compared to conventionally employed EEG features like spectral power features (SPF) and asymmetry index (AI) features
Lopes, De Aguiar, De Souza, & Oliveira-Santos, (2017)	Although automatic face coding systems (AFC) can make predictions to a certain extent, thanks to the new model developed (computer interface), they were able to detect it with 96% accuracy compared to previous measurements
Kietzman, Paschen & Treen, (2018)	The accumulation of this data generated by consumers is constantly increasing
Cannella, (2018)	The content created by many users in the digital environment is analyzed with the help of artificial intelligence tools and the marketing process for businesses is ensured to be carried out in a healthy way
Halkin, (2018)	The study expanded neuromarketing theory by incorporating the actual environmental component with a method to process and evaluate the emotional state of the consumer in purchasing items using galvanic skin response (GSR) and heart beat (HB) devices
Nguyen & Sidorova, (2018)	Customer experience is improved through AI-powered chatbot with Natural Language Processing (NLP)
Perakakis, Mastorakis, & Kopanakis, (2019)	Artificial intelligence is an innovative system that automatically analyzes data generated by consumers for marketers and produces healthier results for businesses, without the need for human intervention to analyze it
Golnar-Nik, Farashi, & Safari, (2019)	The electroencephalogram (EEG) study exhibited a robust predictive capacity for consumer decision-making frequency, achieving a noteworthy accuracy exceeding 87%. Discrimination between "Like" and "Dislike" preferences was similarly demonstrated with an accuracy surpassing 63%. Notably, the most discriminative channels for forecasting decision-making frequency and differentiating preferences were localized to frontal and centro-parietal areas, specifically at Fp1, Cp3, and Cpz
Chatterjee, Ghosh, Chaudhuri, & Nguyen, (2019)	Artificial Intelligence (AI) application is required to analyze customer habits, purchases, likes, and dislikes
Seranmadevi & Kumar, (2019)	Customer Relationship Management (CRM) functions are enhanced through Artificial Intelligence User Interface (AIUI)

Sha & Rajeswari, (2019)	Advanced AI-enabled machine can monitor five human senses and advanced e-commerce business
Tjepkema, (2019)	With artificial intelligence applications, marketers can access most of the information they want about their consumers
Aldayel, Ykhlef, & Al-Nafjan, (2020).	With the deep learning approach to detect consumer preferences using EEG signals, consumer behavior can be predicted with higher accuracy, precision and recall
Huang & Rust, (2021)	Strategic marketing planning can be used to organize existing AI marketing efforts and identify research gaps in AI marketing
Aldayel, Ykhlef, & Al-Nafjan, (2021)	Deep neural network (DNN) created using discrete wavelet transform (DWT) and power spectral density (PSD) used to measure EEG-based preference indices has shown higher accuracy, sensitivity and performance in determining consumer preferences
Jai, Fang, Bao, James III, Chen, & Cai, (2021)	In the study, where 24 participants were asked to make purchasing decisions for 60 garments, consumer preferences were determined with 95% accuracy thanks to machine learning using functional magnetic resonance imaging (fMRI) and visual stimulus effects in 3 categories
Hilken, Chylinski, de Ruyter, Heller, & Keeling, (2022)	It has been claimed that augmented reality (AR) and virtual reality (VR) technologies can make significant contributions to controlling digital content through thought and revealing brain reactions based on digital content
Haleem, Javaid, Qadri, Singh, & Suman, (2022)	AI tools analyze the performance of a competitor's campaigns It can also be used to identify and reveal customers' expectations
Oikonomou, Georgiadis, Kalaganis, Nikolopoulos, & Kompatsiaris, (2023)	In an investigation utilizing a publicly accessible neuromarketing EEG dataset, the devised classification scheme for emotional state recognition and cognitive state recognition demonstrated superior performance, achieving an enhanced classification accuracy exceeding 8% when compared to both baseline and state-of-the-art methodologies
Villegas, (2023)	Artificial intelligence in the context of customer experience, businesses, chat robots, virtual assistants, a wide range of artificial intelligence, such as sentiment analysis and predictive modeling benefits from supported solutions

Source: Created by the author

When the frequently cited studies conducted in the last 14 years in the literature are examined, it is understood that certain neuroscientific methods and tools have been used and, especially as of 2020, more successful results have been achieved by taking advantage of new technological opportunities such as artificial intelligence, machine learning and computer interface.

4. METHOD

In the research, data were obtained according to the studies conducted in the field of neuromarketing, the variety of neuroscientific tools, and whether artificial intelligence applications were used or not. The obtained data were examined with bibliometric analysis. Bibliometric analysis works on the principle of statistical and numerical examination of scientific studies according to certain metrics (Al et al., 2019). In terms of methodology, the studies in the literature are classified and evaluated (Zupic and Čater, 2015). In short, it aims to measure the effectiveness of researchers, groups, institutions and organizations and journals that have conducted studies in the field qualitatively and quantitatively (Krauskopf, 2018). It also has a functional aspect such as guiding future studies by identifying the authors and studies that are active in the literature (Zupic and Čater, 2015). The impact analysis of existing studies is performed by classifying different types of studies conducted in a certain field within a certain period of time (Al et al., 2019). Thanks to the methods and analyses used, it makes it possible to evaluate the findings obtained in the research comprehensively. It is especially important to better understand the quantity and quality of the scientific studies, to determine the power of impact and to determine the direction of general trends.

The articles in the international literature on neuromarketing were examined in the study. Both data sets to be examined within the scope of the study were obtained from the Web of Science (WoS) database. Due to the widespread presence of neuromarketing studies in the literature, a search restriction was imposed on the relevant citation indexes between the years 2010-2024. In addition, studies conducted with artificial intelligence, machine learning and deep learning tools, which are frequently used in neuromarketing research, were taken into account. Another limitation is that the studies in the literature were only scanned through Web of Science (WoS) and other international databases such as Scopus, PubMed, Elsevier ScienceDirect, SpringerLink, Taylor & Francis were excluded from the scope. The main reason for this situation is that very few publications were reached in the literature search. In addition, the language of the studies was English and only articles (excluding articles, book chapters, abstracts, etc.) were included in the analysis, which constitutes another limitation of the study.

This section of the study includes bibliometric analyses of concepts related to the keywords "neuromarketing", "neuromarketing and neuroscientific tools" and "artificial intelligence", "machine learning", "deep learning", which are frequently used tools in neuromarketing research.

4.1. Purpose of the research

Within the scope of the research; as a result of quantitative data and numerical measurement indicators, the concepts of EEG, ET, fMRI, ECG, SCR, AFC, MEG, which are the most frequently used in studies on neuromarketing, neuroscientific tools used in neuromarketing and artificial intelligence, machine learning and deep learning, were included. As a result of the bibliometric analysis, it was aimed to present the studies on the concepts to the attention of researchers from a holistic perspective and to make suggestions on what should be done in future studies.

4.2. Data and analysis

Various bibliometric analysis tools are used in scientific literature. In this study, the R program and the biblioshiny package program were preferred due to their strong functional aspects. This program is considered as an important program that provides convenience to researchers who want to discover evolutions, relationships and new concepts in the literature. The program's visualization, mapping and multidimensional analysis capabilities allow for in-depth examination of data sets. Thanks to these features, researchers can understand developments in scientific fields in more detail and visually analyze relationships in the literature. The use of the Biblioshiny package program provides researchers with an effective tool for understanding and interpreting large data sets. Therefore, the selection of Biblioshiny within the scope of the study was evaluated as an important strategy in terms of providing analytical depth and discovering developments in the literature.

While a great number of studies were found when only neuromarketing-related studies were investigated in the data acquisition process, a limited number of publications were reached in the data acquisition process conducted with neuroscientific tools, artificial intelligence, machine learning and

deep learning concepts. This situation has been interpreted as an indication that artificial intelligence, machine learning, deep learning and more than one neuroscientific tool and method are not used together sufficiently in the field of neuromarketing.

It was created based on bibliometric data of different types of studies scanned in the Web of Science (WoS) database on 02.01.2024 and published between 2010-2024. It was determined that there were 867 studies on "neuromarketing" in the WOS database regarding the concepts specified in the purpose section of the research. However, only 49 studies were reached in the examination conducted with the keywords "neuroscientific tools", "artificial intelligence", "machine learning", "deep learning" used in these studies. The "bibliometrix" package and biblioshiny application developed by Aria and Cuccurullo (2017, p. 959) for the R program were used in the analysis of the obtained data. The R program allows the detailed examination of studies on the subject and the developments to be seen.

5. FINDINGS AND COMMENTS

The findings obtained from bibliometric analyses are presented under this heading. Bibliometric analyses of studies published between 2010-2024 are included. Within the scope of the research, studies indexed in the WOS database were analyzed separately according to the database features they belong to. The results of this evaluation were included in the research through graphs and tables.

In Table 3, the data on the left side belong to the dataset related to "neuromarketing", while the data on the right side belong to the keywords "neuromarketing", "neuroscientific tools" and "artificial intelligence". As can be seen in Table 3, although neuromarketing and artificial intelligence research is 25% less (50 publications and 41 publications), it is seen that the average annual publication is 12% more, the number of authors is higher (184 authors and 194 authors) and the co-authorship per document is higher (3.92 and 5.37) in neuromarketing and artificial intelligence research. This shows that the interest in neuromarketing and artificial intelligence research is increasing.

Table 3. General Information on Data Sets

Description	Results	Description	Results
MAIN INFORMATION ABOUT DATA		MAIN INFORMATION ABOUT DATA	
Timespan	2010:2024	Timespan	2010:2024
Sources (Journals)	30	Sources (Journals)	32
Documents	50	Documents	41
Annual Growth Rate %	0	Annual Growth Rate %	12,25
Document Average Age	5,38	Document Average Age	3,8
Average citations per doc	21,56	Average citations per doc	21,32
References	2725	References	1602

DOCUMENT CONTENTS		DOCUMENT CONTENTS	
Keywords Plus (ID)	206	Keywords Plus (ID)	87
Author's Keywords (DE)	155	Author's Keywords (DE)	167
AUTHORS		AUTHORS	
Authors	184	Authors	194
Authors of single-authored docs	5	Authors of single-authored docs	3
AUTHORS COLLABORATION		AUTHORS COLLABORATION	
Single-authored docs	5	Single-authored docs	3
Co-Authors per Doc	3,92	Co-Authors per Doc	5,37
International co-authorships %	30	International co-authorships %	31,71
DOCUMENT TYPES		DOCUMENT TYPES	
Article	50	Article	41

Figure 4 shows the annual average production of publications in the field of neuromarketing, while Figure 5 shows the annual average production of research on the use of neuromarketing and artificial intelligence. While the average number of publications in the field of neuromarketing in 2021 was approximately 8, this number decreased by more than 300% to 2.5 in 2023. While the number of publications on the combined use of neuromarketing and artificial intelligence was 3 in 2021, this number increased by 100% in 2023, increasing to an annual average of 6 publications. Although the evaluation was conducted to cover the last 14 years, it is understood that 50 studies evaluated in the field of neuromarketing were conducted in this period, while the majority of the studies (41 studies) in the field of neuromarketing and artificial intelligence were conducted in the last five years. This shows that the interest in the use of artificial intelligence in neuromarketing research is increasing.

Figure 4. Neuromarketing Research

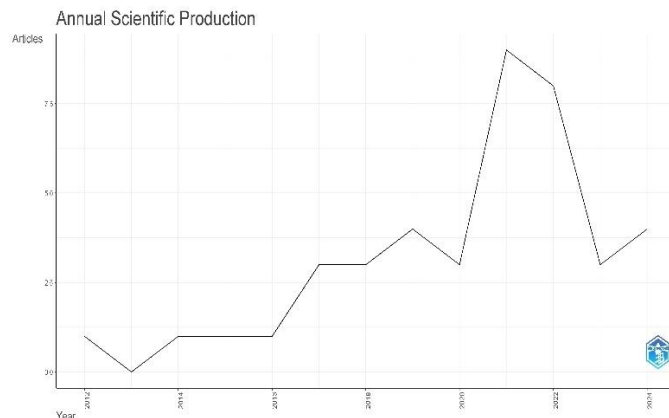
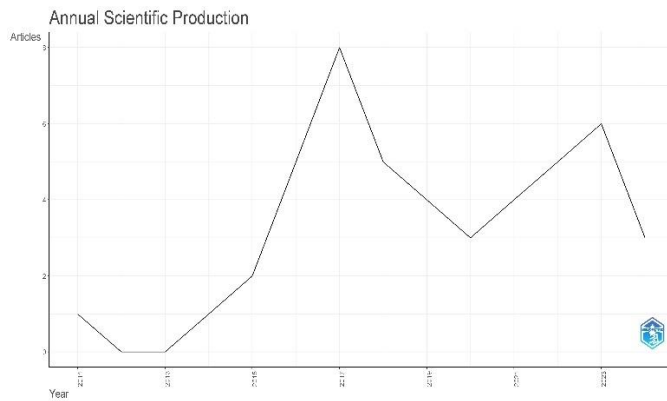
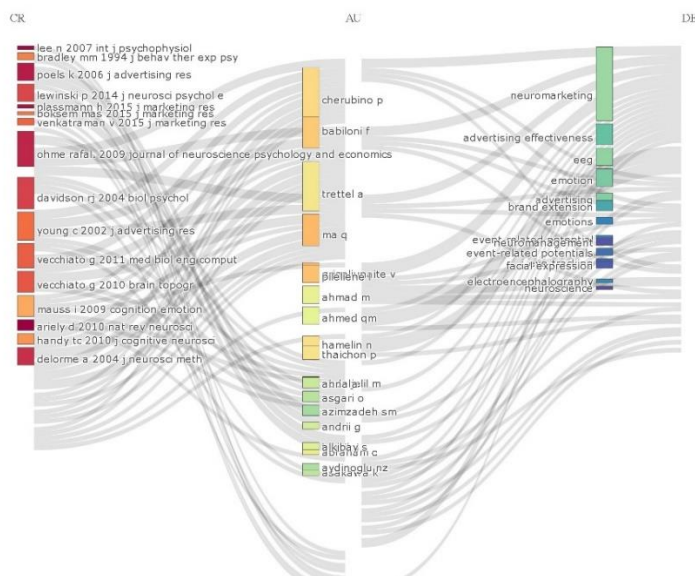


Figure 5. Neuromarketing and Artificial Intelligence Research



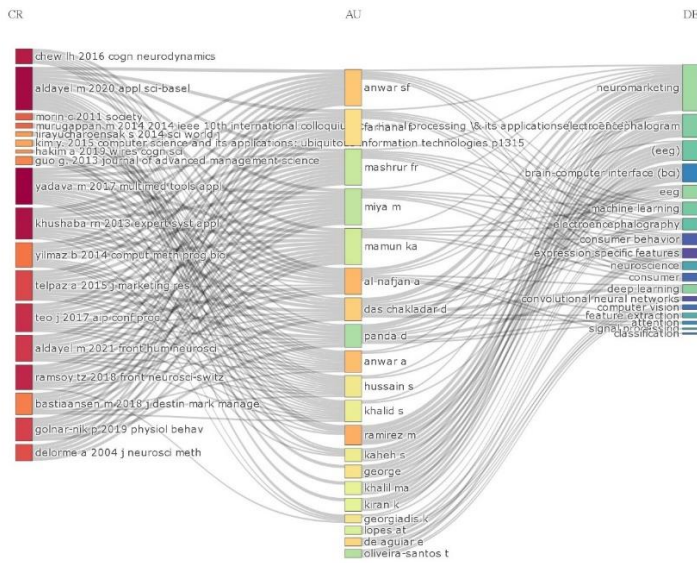
While Cherubino and Babiloni are the researchers who have done the most work in the field of neuromarketing, the most frequently used keywords by the authors are neuromarketing and EEG, as seen in Figure 6. This shows that one or two neuroscientific tools are usually used in the studies.

Figure 6. Sources, Authors and Keywords for Neuromarketing



While Anwar and Farhan are the researchers who have done the most work in the field of neuromarketing and artificial intelligence, the most frequently used keywords by the authors are neuromarketing, EEG, machine learning and deep learning, as seen in Figure 7. This shows that more than one neuroscientific tool and artificial intelligence are usually used together in the studies.

Figure 7. Sources, Authors and Keywords for Neuromarketing and Artificial Intelligence



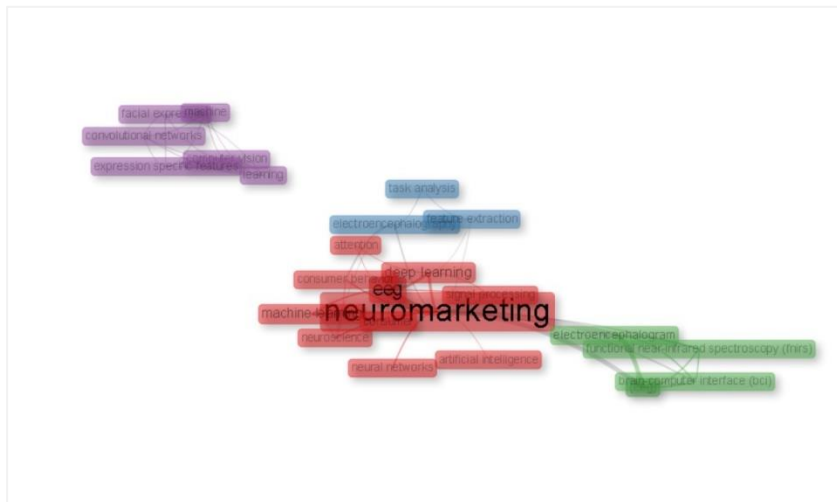
In the analysis conducted to reveal the conceptual structure of the studies (according to the abstracts of the studies), it is seen in Figure 8 that in the study conducted in the field of neuromarketing, the concepts of neuromarketing and only EEG are included in the same cluster and other neuroscientific tools are not present. This situation shows that generally one or at most two neuroscientific tools are used in the studies conducted. However, it is understood that all reactions created by more than one stimulus can be tried to be measured with a single tool.

Figure 8. Co-occurrence Network for Neuromarketing



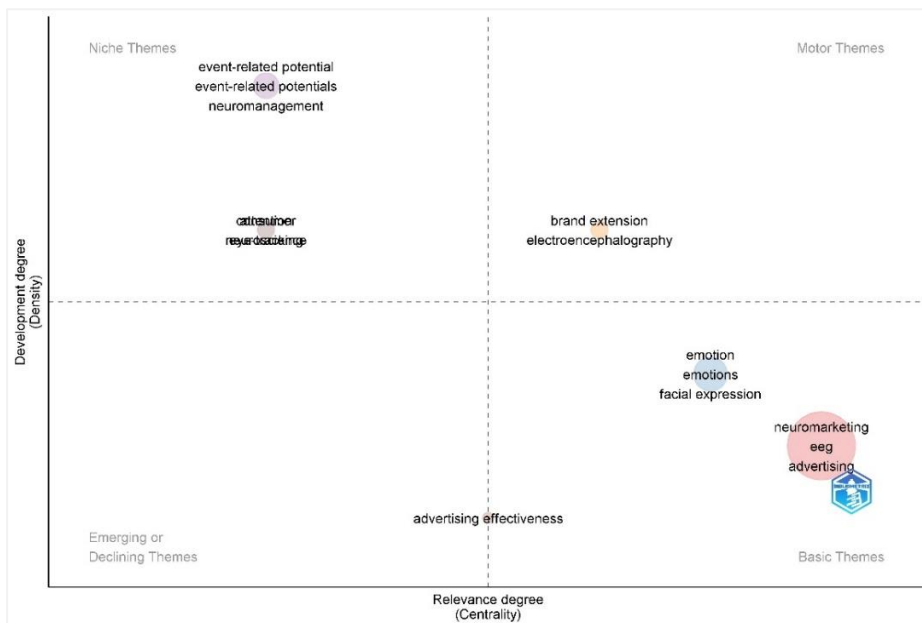
However, in the analysis of the conceptual structure of studies on neuromarketing and artificial intelligence (according to the abstracts of the studies), it is seen in Figure 9 that neuroscientific tools such as neuromarketing, EEG, facial annotation and fMRI are used and the concepts of artificial intelligence, machine learning and deep learning are also included in the same cluster. This shows that more than one neuroscientific tool is used in the studies and artificial intelligence is effective in the studies.

Figure 9. Co-occurrence Network for Neuromarketing and Artificial Intelligence



Another analysis made regarding the conceptual structure is the thematic mapping analysis made according to the keywords used by the authors. In the studies conducted in the field of neuromarketing, neuromarketing, EEG and facial description topics are included together according to the keywords used by the authors and these are the main topics as seen in Figure 10. It is understood that the concepts of EEG and brand extension are motor themes. This situation shows that neuroscientific tools are used limitedly in the studies conducted in the sense of neuromarketing.

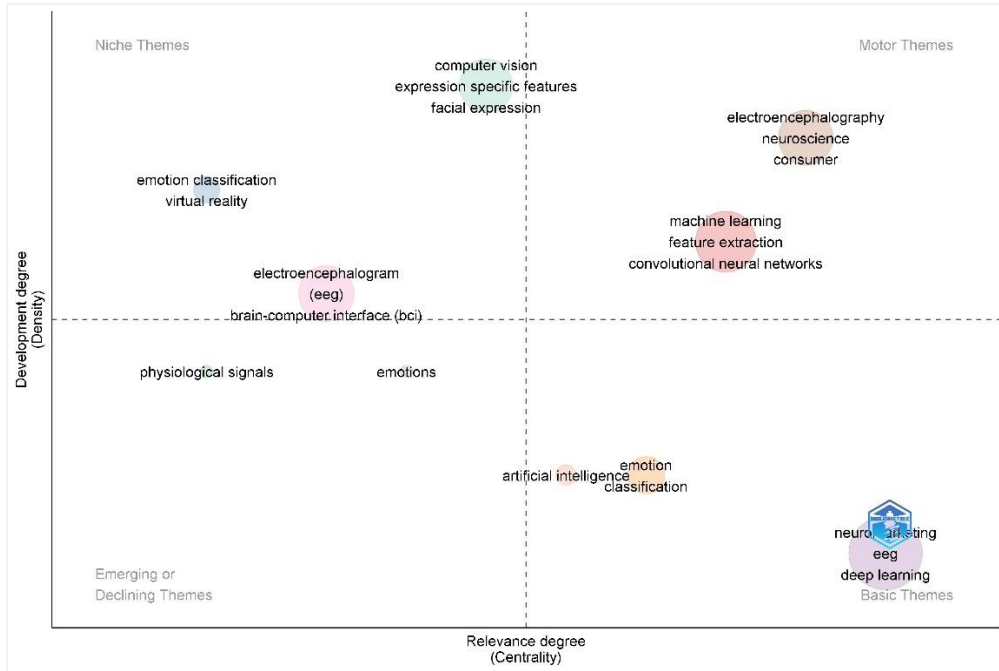
Figure 10. Conceptual Structure Map for Neuromarketing (According to Author Keywords)



However, in the thematic mapping made according to the keywords used by the authors in the studies on neuromarketing and artificial intelligence, it is seen in Figure 11 that the basic topics of neuromarketing, EEG, deep learning, artificial intelligence, and emotion classification are included together and that these are the basic topics. It is understood that the concepts of machine learning, feature extraction, EEG, and consumer neuroscience are motor themes. In addition, the concepts of emotion

classification, EEG, and brain-computer interface are niche concepts and they will be used much more frequently in the near future. This situation shows that more neuroscientific tools will be used in neuromarketing and artificial intelligence and the obtained data can be processed by artificial intelligence with the help of systems such as brain-computer interface.

Figure 11. Conceptual Structure Map for Neuromarketing and Artificial intelligence (According to Author Keywords)



The most frequently used word cloud analysis based on author keywords is shown in Figure 12, where the most frequently used words in the field of neuromarketing are neuromarketing and EEG.

Figure 12. Neuromarketing Wordcloud



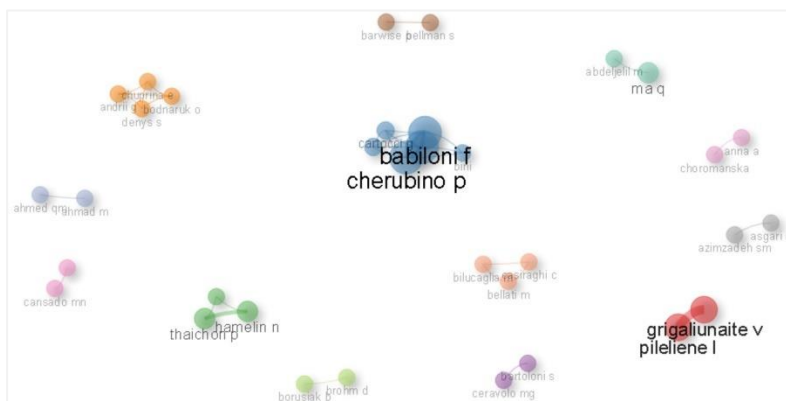
In the most frequently used word cloud analysis based on author keywords, it is seen in Figure 13 that the most frequently used words in the field of neuromarketing and artificial intelligence are neuromarketing, EEG, machine learning and deep learning. This shows that neuromarketing and artificial intelligence-based research is increasing.

Figure 13. Neuromarketing and Artificial Intelligence Wordcloud



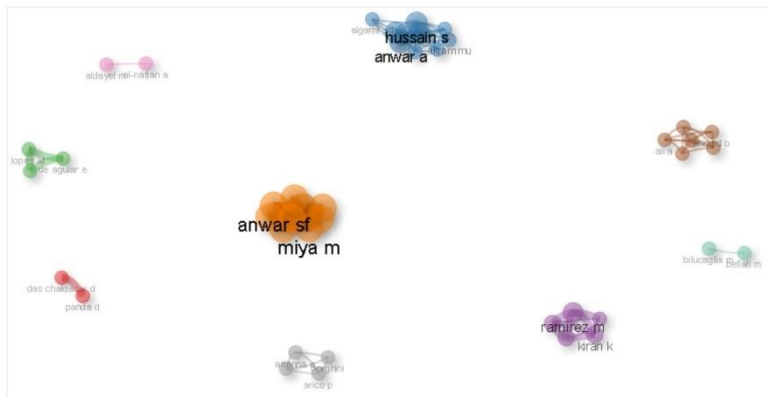
In the collaboration analysis conducted among the authors to examine the studies in terms of social structure, Cherubino and Babiloni stand out in the field of neuromarketing as seen in Figure 14. The connection consisting of 13 clusters, the fact that the nodes and connections in the collaboration are relatively high compared to other author collaborations, indicates that the studies are frequently conducted between certain authors and multidisciplinary approaches are limited.

Figure 14. Collaboration Network among Authors in Neuromarketing



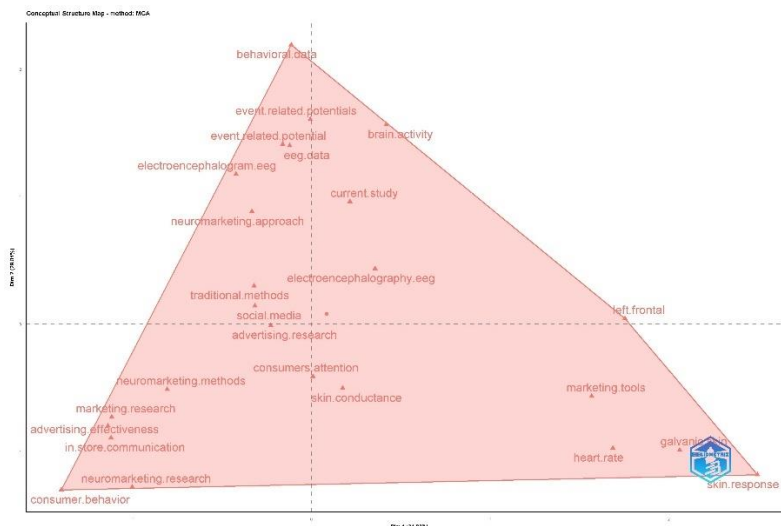
In the collaboration analysis conducted among the authors to examine the studies in terms of social structure, Anwar and Miya stand out in the field of neuromarketing and artificial intelligence as seen in Figure 15. In the connection consisting of 9 clusters, it is seen that Anwar is included in more than one cluster and the collaboration nodes and connections between the authors are high. This shows that the authors and multidisciplinary approaches are adopted more.

Figure 15. Collaboration Network among Authors in Neuromarketing and Artificial Intelligence



When the conceptual structure map of studies conducted in the field of neuromarketing is examined (according to Multiple Correspondence Analysis, Bigrams and Abstarcts analysis), it is seen in Figure 16 that the concepts of EEG, social media, advertising research are close to the center, but the concepts of galvanic skin, heart rate, skin conductance and neuromarketing research are far from the center. This situation indicates that neuroscientific tools have not yet been used sufficiently in neuromarketing research. According to factor analysis, it is understood that the concepts are gathered in a single cluster and different neuroscientific tools are not included.

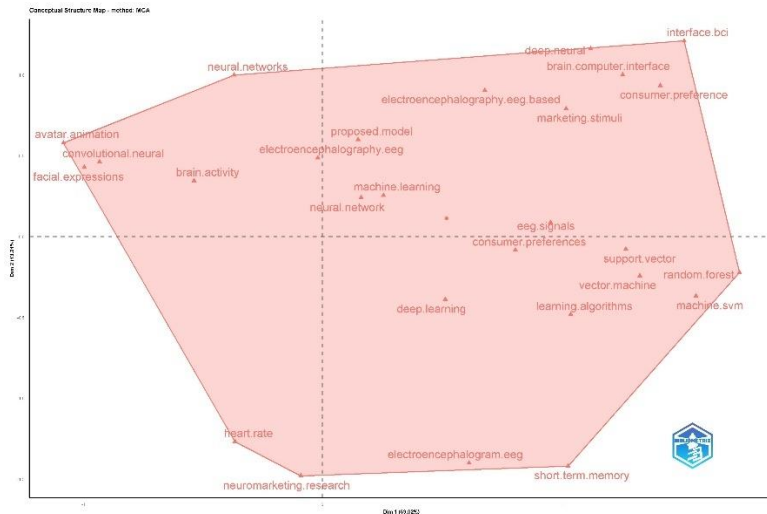
Figure 16. Neuromarketing Factor Analysis



When the conceptual structure map of studies conducted in the field of neuromarketing and artificial intelligence is examined (according to Multiple Correspondence Analysis, Bigrams and Abstarcts analysis), it is seen in Figure 17 that neuroscientific tools and approaches such as EEG, heart rate, facial expressions, brain activity and neural networks are included. At the same time, it is seen that concepts such as deep learning, machine learning, brain-computer interface also evoke approaches related to artificial intelligence and are collected under the same factor. This indicates that

neuroscientific tools are being used more in neuromarketing research and that the demand for processing the obtained data through artificial intelligence-based algorithms may gradually increase.

Figure 17. Neuromarketing and Artificial Intelligence Factor Analysis



6. DISCUSSION

When the studies conducted in the field of neuromarketing are examined, it is seen that neuroscientific tools are generally used with one or at most two tools. The most frequently used tools are EEG, ET and fMRI. Psychoneuroendocrinological approaches have been neglected in studies based on neurophysiological and neuropsychological activation data. However, individuals make decisions not only when making purchasing decisions but also by using their past experiences, emotions and thoughts when making many decisions. Therefore, these decisions may differ depending on the environment and external stimuli in which the person is located. The underlying reason for this is that neural activity makes decisions under the influence of hormones and brain chemicals (neurotransmitters) when exposed to any external stimulus (marketing stimuli). Because when the consumer makes a decision, the neural activity that occurs in the relevant brain region (Brodmann areas) occurs together with the release of brain chemicals. It is understood that this situation is neglected in the studies. Another issue is that the studies are conducted using one or at most two tools. This is because experimental designs are assumed to be costly, time-consuming, and difficult. In addition, obtaining all the data at the same time is another difficulty when more than one tool is used. For example, the eye movements and facial muscle differences or neurophysiological activity of the participant during the response to visual, auditory, etc. stimuli should be recorded and evaluated simultaneously. Therefore, it is of particular importance for businesses and marketing researchers to make greater use of neuroscientific tools in neuromarketing research and to evaluate the obtained data with artificial intelligence-based applications. Although there are studies in this field, especially by Seranmadevi & Kumar, (2019), Sha & Rajeswari,

(2019), Tjepkema, (2019), Huang & Rust, (2021), Haleem et al. (2022), Villegas, (2023), it is understood that they are not yet at the desired level.

7. CONCLUSION AND RECOMMENDATIONS

Neuroscientific tools and methods have an important place in neuroscience research and have found a wide range of use in various scientific studies. However, a large portion of these studies focus on neurophysiological activity and generally prefer the use of single neuroscientific tools. This limited approach may prevent a full understanding of consumer thinking and behavior patterns. Neural activities triggered by marketing stimuli occur simultaneously in many regions of the brain and mind, and this can manifest itself in both physical behavior and psychological attitudes. Therefore, neuroscientific research needs to be conducted with more comprehensive and integrated methods. Studies conducted using low-cost methods and tools, integrating these tools with a common experimental design, and processing the obtained data with advanced algorithms such as artificial intelligence or machine learning are of great importance. Any neural activity in the human brain is not limited to a single phenomenon or action; it is a complex set of responses that emerge as a result of the interaction of more than one neural network. In order to process this complex data accurately and effectively, advanced technologies such as artificial intelligence, computer interfaces and machine learning that can analyze millions of data simultaneously are needed. Otherwise, the data collected manually will be limited and will only cover a certain time period, which may cause the findings to be misleading. For example, in studies conducted in the field of neuromarketing, brain imaging techniques (such as fMRI, EEG) are frequently used during the analysis of consumers' responses to marketing stimuli. As a result of the research, the assumption that more effective results can be obtained with the combined use of eye tracking, EEG and fMRI, which are the most commonly used tools in neuromarketing research, is consistent with the study conducted by Yağcı et al. (2013). Another finding obtained in the research is that the processing of information obtained from digital platforms and other media with artificial intelligence-based algorithms is compatible with the study by Bowen (2009) and Maxwell et al. (2011) in terms of understanding consumer behavior and processes. Analyzing the findings obtained with neuromarketing tools regarding consumer habits, purchasing behaviors, likes and dislikes with artificial intelligence applications can yield much more realistic results. This is consistent with the research of Chatterjee et al. (2019). Considering the authors and keywords obtained in bibliometric analysis, it is accepted as a result of the research that artificial intelligence is an innovative system that automatically analyzes the data produced by consumers for marketers and produces healthier results for businesses without the need for human intervention for analysis. This result is consistent with Perakakis et al. (2019). In the context of customer experience, AI, businesses, chatbots, virtual assistants, sentiment analysis, and predictive modeling benefit from a wide range of AI domains supported solutions. These results are consistent with Villegas (2023), Haleem et al. (2022), Huang & Rust, (2021), Seranmadevi & Kumar, (2019), Sha & Rajeswari, (2019) Tjepkema, (2019). Neuromarketing has the potential to be more cost-effective than traditional

methods and can reveal valuable insights during the product design phase. This has an important place in reducing costs. These findings obtained in the research are similar to Ariely & Berns, (2010), Fortunato et al. (2014). As a result of comparing the studies conducted with neuroscientific tools and methods in the literature, it was revealed in the studies conducted by Tjepkema, (2019) and Huang & Rust, (2021) that evaluating the findings obtained only by human hands is difficult, costly, time-consuming and ineffective. As a result of the research, it was concluded that using only neuroscientific tools alone is not sufficient and that it is inevitable to benefit from machine learning, deep learning and artificial intelligence-based applications of the information obtained.

However, the use of these techniques alone is limited to monitoring activities in certain regions of the brain and cannot fully reflect the holistic functioning of the brain. Since there is an effort to access more than one piece of information in studies, it is necessary to use more than one neuroscientific method, tool and approach in studies. The main reason for this is that while only brain activities can be monitored with brain imaging techniques, different tools and methods need to be used together to examine other physiological reactions. For example, while brain activities are observed with EEG or fMRI, heat increases in the skin can be monitored with galvanic skin conductance, and changes in the autonomic nervous system can be examined with heart rate. Thanks to such a holistic approach, it is possible to understand the neurophysiological, psychological and biological reasons of consumer behavior much better. However, considering the size of the data obtained from the methods and tools used, it is quite difficult to process these data together (correlation or regression). Because the data in the data set is quite large. At this point, it is much easier and much more realistic to process such large data and derive meaningful results thanks to machine learning and artificial intelligence. Making large and complex data sets understandable not only within themselves but also in their relationships with each other with hidden patterns and structures with mathematical formulas provides a much better understanding of consumer emotions, cognition, thoughts and behaviors. In this way, neuromarketing guides marketing managers to reveal the deficiencies or flaws of a product or service that has not yet entered the production phase or to make more effective sales. However, research in the field of neuromarketing requires the coordinated work of researchers who are experts in the fields of neuroscience, marketing, psychology, data science, computer engineering and artificial intelligence. Because neuromarketing requires adopting a multidisciplinary approach. Otherwise, as in previous studies, some of the reasons behind consumer emotions, thoughts, cognition and behavior will always remain missing. Therefore, in neuromarketing research, more than one neuroscientific tool (ET, EEG, EMG, fMRI, ECG, GSR, heart beat, TMS etc.) should be used together and the obtained data should be evaluated together with artificial intelligence-based applications. Working together with experts from different fields will add depth to the research to be conducted and will enable the emergence of innovative solutions. In addition, it is important for marketers who want to conduct neuromarketing research to receive a certain level of neuroscience education. The main reason for this is that knowing

neuroscience at a certain level will add depth and richness to the studies so that the neuroscientific tools and methods used in the research can be used more effectively in the studies.

As a result, the use of more neuroscientific tools and methods together in studies to be conducted in the field of neuromarketing and the processing of the obtained data with machine learning, deep learning, and artificial intelligence applications will allow for a much better understanding of consumer behavior and processes. The adoption of a multidisciplinary approach and innovative technologies in future studies will take neuromarketing science to a much more advanced level than it is today. In order to better understand consumer behavior, decision-making, habits and tendencies, artificial intelligence-based applications in neuromarketing research should be used in marketing research. In this way, it will be easier to produce and implement consumer-centered, goal-oriented, high-satisfaction, cost-effective marketing strategies. This will not only increase the profitability of businesses, but will also allow for happier and more loyal customer relationships.

The study does not necessitate Ethics Committee permission.

The study has been crafted in adherence to the principles of research and publication ethics.

The author declares that there exists no financial conflict of interest involving any institution, organization, or individual(s) associated with the article.

The entire work was carried out by its only, stated author.

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Exploring the Links Between Employee Resilience and Career Satisfaction: The Roles of Job Crafting and STARA Awareness

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Abstract

In a dynamic business environment where challenges are inevitable, the success of an organization depends on the resilience demonstrated by its employees. Prior studies provide valuable information on employee resilience and its outcomes; however, there is limited knowledge of how employee resilience influences career outcomes. Drawing on Job Demands-Resources Theory, this study explores the mediating effect of job crafting on the relationship between employee resilience and career satisfaction. Also, this study examines whether smart technology, artificial intelligence, robotics, and algorithms (STARA) awareness moderates the relationship between those variables. The study sample consists of 321 individuals employed in white-collar positions within various enterprises in Turkey. Structural equation modeling was used to test the research hypotheses. The findings indicate that job crafting significantly mediates the relationship between employee resilience and career satisfaction. Additionally, STARA awareness moderates the relationship between employee resilience and job crafting, whereas there is no conditional indirect effect between employee resilience and career satisfaction. This study presents practical implications for white-collar workers' career attitudes in business environments characterized by increased digitalization.

Keywords: *Employee Resilience; Job crafting; Career Satisfaction; STARA Awareness.*

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1. INTRODUCTION

Resilience refers to the capacity to withstand and overcome difficulties and adversities, encompassing the ability to adapt to and cope with unfavorable circumstances. Demonstrating this capacity may restore or shift equilibrium following encounters with adverse circumstances and events. Resilience is widely acknowledged as an essential feature that exhibits a strong association with the competitive advantage of socio-ecological systems at the individual, organizational, and national levels (Walker et al., 2004). The concept of resilience has been the subject of extensive research across several academic fields, such as industrial psychology, human resources management, and organizational behavior (Gerçek & Yılmaz Börekçi, 2021). Employee resilience, which pertains to the ability of individuals to successfully cope with and adjust to unanticipated negative circumstances in the workplace, has emerged as a critical factor in achieving organizational effectiveness (Bardoel et al., 2014). In addition, the resilience of employees is of great significance in influencing the course of their careers, as it provides them with the ability to effectively navigate obstacles and adapt to the constantly increasing demands they face within the work environment.

In recent decades, there has been a significant transformation in the employment field due to delayering, restructuring of organizations, and financial globalization. The literature on careers has experienced a shift in focus throughout time, transitioning from traditional hierarchical career paradigms to more contemporary concepts known as "new" careers, which are characterized by their non-linear nature and lack of boundaries (Briscoe & Hall, 2006). Employees who can handle challenging work environments and achieve career satisfaction might be viewed as resilient from a career standpoint. Effectively recovering from adversity allows employees to navigate and endure unfavorable circumstances, such as adverse career occurrences. Recent research findings indicate a significant and noteworthy correlation between resilience and career satisfaction (Srivastava & Madan, 2020).

Certain employee habits are of utmost importance to effectively adapt to and navigate through changes, particularly during a time when human resources are increasingly precious. The strategies employed by workers to navigate and adapt to changes possess the capacity to foster effective change initiatives within firms comprehensively. Furthermore, the use of these strategies has the potential to facilitate a constructive adaptation to organizational change, thereby enhancing employees' overall job satisfaction and well-being (Petrou, 2013). Job crafting, known as behavior, involves employees choosing to abstain from certain tasks when they sense a lack of compatibility between their job and their work environment (Tims et al., 2022). Job crafting, as initially defined by Wrzesniewski and Dutton (2001), pertains to the proactive efforts of workers to reframe and reshape their jobs without external influence. Employee resilience and job crafting have close connections since the capacity to overcome challenges frequently creates a proactive attitude that allows people to modify and maximize their jobs within an organization (Van Wingerden & Poell, 2019). According to Vogt et al.'s (2016) study, individuals who deliberately build a creative and demanding work setting for themselves might

experience benefits including resilience. Also, there is evidence that job crafting promotes resilience during a crisis (Sahay et al., 2022).

The rapid advancement of “*smart technology, artificial intelligence, robotics, and algorithms*” (STARA) has played a pivotal role in the digital era. Numerous firms have embraced STARA technology in their operations to align themselves with the current trend, owing to the advantages of enhanced efficiency, cost reduction, distinctiveness, improved customer experience, and ultimately, enhanced overall performance (Ding, 2021). STARA possesses the potential to jeopardize an individual's comprehensive professional growth and introduce additional obstacles in the pursuit of personal fulfillment. STARA may present a challenge to individuals' sense of control since the external environment can impact employees' views of achieving their career objectives. This will probably exert a detrimental impact on one's level of career satisfaction (Brougham & Haar, 2018). Individuals who are aware of STARA technologies and how they might improve work procedures, skills, and well-being are more likely to actively interact with and exploit these tools to strengthen their resilience and job happiness. Therefore, we also tested the potential moderating function of STARA awareness in the relationship between employee resilience, job crafting, and career satisfaction.

Drawing upon the Job Demands-Resources (JD-R) theory, we posit that job crafting might serve as an intermediary mechanism, wherein employee resilience functions as an individual resource. Employees who possess resilience, coping skills, and flexibility are more inclined to actively craft their jobs. Through the process of job crafting, individuals can modify their job demands in a way that aligns with their strengths and preferences. This strategic adjustment allows them to reduce the adverse effects of stressors while simultaneously maximizing the positive impact of available resources. As a result, their overall career satisfaction could be enhanced. Thus, this research points out the significance of job crafting as a mechanism within the JD-R framework, whereby employee resilience results in improved career outcomes, particularly career satisfaction. The moderating effect of STARA awareness on the relationship between employee resilience and job crafting and the moderated-mediating effect of STARA awareness was tested. Through examination of mediation and moderation, valuable insights may be obtained on the role of job crafting in mediating the relationship between employee resilience and career satisfaction. Additionally, this approach allows for the identification of circumstances that can either strengthen or weaken the strength of this relationship. Studying both job crafting and STARA awareness represents the multifaceted nature of contemporary workplaces. The comprehensive methodology utilized in our research offers valuable insights for organizations seeking to assist employees in job crafting and maximizing technology utilization.

2. THEORETICAL BACKGROUND AND HYPOTHESES

2.1. Employee Resilience and Career Satisfaction

Globalization, with the advent of the information age and the network economy, has significantly increased the degree of contact among various players within the business environment, resulting in a highly interconnected system (Duchek, 2020). Consequently, the presence of negativity within an external environmental variable exerts a cascading influence on other entities. Carmeli et al. (2013) claim that resilience is a two-dimensional trait that includes the ability to cope with problems and change in response to them. Resilience capability refers to the capacity to generate or maintain cognitive, emotional, relational, or functional resources that facilitate organizational learning and adaptation in response to unforeseen events. According to Vogus and Sutcliffe (2007), this capacity is based on procedures, structures, and practices that assist businesses in enhancing organizational competence, increasing productivity, and expanding and developing novel competencies. Organizations acquire the capacity to endure and maintain their operations by acquiring the skills necessary to effectively manage adverse circumstances they confront. Thus, building employee resilience is essential for successful adaptation to and reaction to environmental changes (Wang et al., 2014).

Researchers have proposed many conceptualizations of individual resilience, including its characterization as a fixed personality characteristic, a changeable ability that may be developed through time, or a dynamic process. Resilience, as conceptualized by the trait viewpoint, is understood as a distinct and enduring personal attribute or a collection of many personal qualities. This suggests that individuals who possess resilience are often better at surviving and overcoming adversity and failures compared to those who lack resilience (Shin et al., 2012). Employee resilience is defined as “*the capacity of employees to utilize resources to continually adapt and flourish at work, even when faced with challenging circumstances*” (Kuntz et al., 2016). Previous research has demonstrated that employee resilience influences certain employee attitudes and behaviors. Employee resilience has been determined to have a positive relationship with organizational commitment (Shin et al., 2012), job satisfaction (Meneghel et al., 2016), organizational citizenship behavior (Toor & Ofori, 2010), employee performance and effectiveness (Luthans et al., 2011), job happiness and well-being (Wilson and Ferch, 2005). From the perspective of the JD-R Theory which suggests that within every organization each job has its demands and resources, demands can operate as stressors, whereas resources refer to aspects that contribute to the well-being of employees (Bakker et al., 2023). Resilience functions as an intrinsic asset that can mitigate the effects of work pressures on employees' emotional and psychological well-being. Thus, resilient employees can perceive challenges as opportunities for growth and development, leading to greater mastery over their careers and increased career satisfaction.

Career satisfaction which has been a concept of significant focus to career researchers is defined as “*satisfaction with one's career as a whole and job satisfaction as overall satisfaction with one's present job*” (Lounsbury et al., 2003:292). Career satisfaction is a state of cognitive and emotional

contentment that indicates a positive level of adjustment in one's job. Satisfaction among individuals is derived from the attainment of professional success, the advancement made in fulfilling overarching career objectives, as well as the accomplishment of goals about income, skills enhancement, and career progression (Greenhaus et al., 1990). Prior studies provide evidence of the significant effect of employee resilience on career satisfaction (Wei & Taormina, 2014). Additionally, Lyons et al. (2015) state that resilience positively affects career satisfaction. Hence, the ability to demonstrate resilience in the face of work-related challenges and adversities is likely to foster a sense of determination in achieving career goals, ultimately, this will result in a sense of fulfillment in one's career. Therefore, we propose the following hypothesis:

H1: Employee resilience positively affects career satisfaction.

2.2. Employee Resilience and Job Crafting

Job crafting was initially proposed by Wrzesniewski and Dutton (2001, p. 179) as *“the physical and cognitive changes individuals make in the task or relational boundaries of their work.”* Job crafting is an interval variable between commitment and performance based on the JD-R Theory (Demerouti & Bakker, 2011). There are four forms to define work characteristics by using the difference between job demands and job resources: *“increased structural job; increased social job resources; increasing challenging job demands; and decreasing hindering job demands”* (Tims et al., 2012). Rudolph et al. (2017) provided a meta-analysis research that examined the antecedents of job crafting, with a particular focus on individual characteristics like personality traits and self-organization abilities. Additional factors that might influence outcomes are work characteristics and demographic traits. Employee resilience, as an individual capacity that can affect working skills, can serve as an important determinant in this context. According to Hartmann et al., (2020), many components of employee resilience encompass a range of abilities, including self-reliance, internal control focus, emotional intelligence, and empathy. These skills may contribute to individuals redefining their jobs. Several studies have indicated that self-sufficiency serves as an antecedent to job crafting (Kim et al., 2018; Tims et al., 2014). Lazazzara et al. (2020) argue that the act of job crafting may be seen as including two distinct aspects. These are proactive strategies that employees may take to enhance their job performance, as well as reactive strategies to effectively manage the pressures arising from organizational change. Employee resilience can affect job crafting positively, as it represents both the acquisition of new resources to improve performance and the ability to cope with change and challenges. On the other hand, resilience varies in individuals depending on different circumstances and different reactions. This indicates that resilience has a non-stable nature (Henley, 2010). More clearly, crisis-specific responses are situation-unique, as each crisis may have its characteristics. From this perspective, employee resilience may promote job crafting. Thus, we hypothesize:

H2: Employee resilience positively affects job crafting.

2.3. The mediating Role of Job Crafting

According to JD-R Theory, job crafting enables workers to adapt to changes in their workplaces more skillfully. According to Lichtenhaler and Fischbach (2018), employees who can effectively manage job demands and resources are more likely to experience increased motivation, improved health, and enhanced performance outcomes. The concept of job crafting is widely recognized as having a positive impact on several aspects of the work environment, including job satisfaction, devotion, job performance, and contextual performance (Rudolph et al., 2017). Job crafting is an important variable concerning the satisfaction individuals derive from their careers. It is due to the likelihood that engaging in job crafting activities would improve the alignment between an individual and their job, therefore fulfilling their career-related requirements and subsequently augmenting their overall career satisfaction (Dubbelt et al., 2019). Kundi et al. (2021) proposed that individuals who possess more flexible career attitudes are inclined to exhibit job crafting behavior, which in turn contributes to the increase in career satisfaction. Also, Kim and Beehr (2018) showed that job crafting directly affects career satisfaction. Moreover, task crafting enables employees to modify their job duties in response to the evolution of their interests, abilities, and ambitions as well as unexpected changes. The capacity to adjust to evolving conditions fosters a perception of flexibility and control in shaping one's career path, hence resulting in heightened levels of job career satisfaction (McKevitt et al., 2022). Thus, we hypothesize:

H3: Job crafting positively affects career satisfaction.

Job crafting was considered as a mediator variable in prior studies with resilience as an outcome (Hur et al., 2023; Kwon et al., 2019). Employee resilience is related to increased autonomy, person-job fit, enhanced relational sources, and capacity to adapt (Bardoel et al., 2014). Given that job crafting may occur in settings where employees have a larger sense of autonomy and are provided with opportunities to interact with others to acquire relational assets (Rudolph et al., 2017), employee resilience may increase the possibility of job crafting. Furthermore, research has indicated that job crafting has a significant role in determining career satisfaction since it has the potential to enhance the alignment between a person and their job (Dubbelt et al., 2019). Resilient employees may proactively alter their job responsibilities and activities to better correspond with their preferences, abilities, and long-term career objectives through job crafting, which may strengthen the link between employee resilience and career satisfaction. Through this process, they may make the most of their resources, reduce stress, and increase engagement, all of which eventually result in improved levels of career satisfaction. Thus, we hypothesize:

H4: Job crafting mediates the relationship between employee resilience and career satisfaction.

2.4. The Moderator Role of STARA Awareness

The Fourth Industrial Revolution has been driven by the progress made in smart technology, artificial intelligence, robotics, and algorithms (STARA) (Brougham & Haar, 2018; Ding, 2021). This

has resulted in a significant and far-reaching change in several aspects of daily life. Smart technology plays a substantial part in contemporary digital work settings. Organizations allocate significant resources towards technological advancements, and the level of employee knowledge and effective exploitation of these tools may significantly impact their career achievements. The recognition of the role of smart technology awareness as a driving force may guide companies in their efforts to foster technology literacy and empower employees to effectively utilize technology for their benefit. SMART technologies, sometimes known as "*technological disruptions*," have the potential to hinder employees' ability to properly accomplish their tasks. For example, these disruptions have the potential to impact all aspects of one's career, including career planning, career satisfaction, and career success (Brougham & Haar, 2023). Theoretically, career development is influenced by the ability of employees to adapt to the specific contextual conditions in which they work (Savickas et al., 2009). Thus, STARA awareness is a key factor to consider in the study as it serves as a contextual element that may impact the extent of the relationship between employee resilience and career satisfaction. In the modern era, which is characterized by the growing integration of technology in the workplace, the level of employees' knowledge and skill with smart technology has the potential to impact their utilization of resilience strategies.

The concept of STARA awareness relates to the proactive recognition by workers of the possibility of technological advancements leading to the displacement of their jobs (Oosthuizen, 2022). The existing body of literature has examined employees' views of STARA and its possible impact on their career, emotional well-being, psychological well-being, and placement of job prospects. According to Lestari and Djastuti (2020), projections suggest a significant quantity of occupations that will potentially undergo automation in the foreseeable future. Additionally, some prior studies have mainly shown STARA awareness in a very unfavorable manner, linking it to many adverse outcomes like reduced organizational commitment, heightened cynicism, sadness, and intentions to leave the company (Brougham and Haar, 2018). The research done by Lingmont and Alexiou (2020) demonstrated a notable correlation between individuals' understanding of STARA and their perception of job insecurity. Nevertheless, as stated by Oosthuizen (2022), STARA presents potential opportunities for developing innovative professional roles and acquiring highly desirable digital-era competencies. Regarding the current research, it has been postulated that STARA functions as a moderator in the association between study variables. Thus, we hypothesize that,

H5: STARA Awareness moderates the relationship between employee resilience and job crafting, such that the relationship between employee resilience and job crafting is stronger among employees with greater levels of STARA awareness.

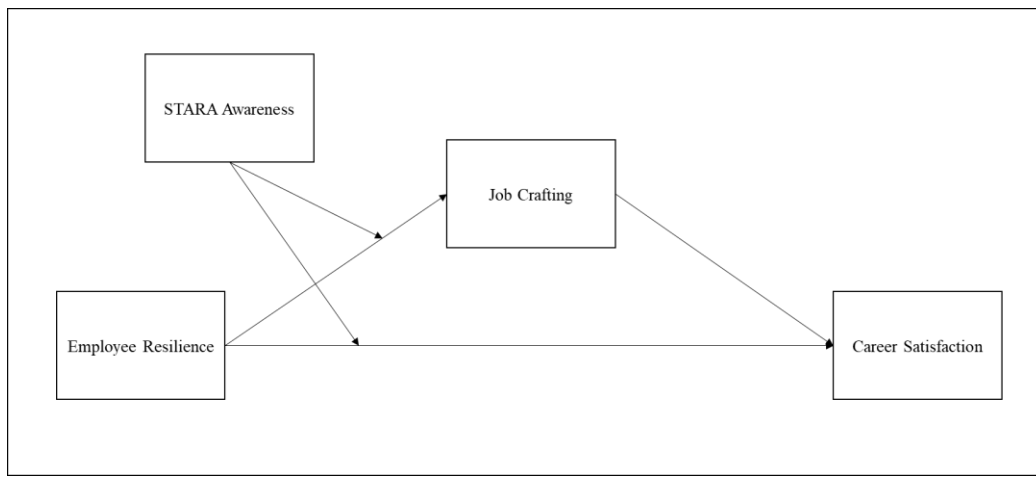
Since previous studies linked STARA awareness to career satisfaction (Brougham & Haar, 2023), this study aims to investigate not only the presence of the moderating role of STARA awareness

but also the potential moderating-mediating role of STARA awareness on the indirect effect of job crafting on the link between employee resilience and career satisfaction. So, we hypothesize that,

H6: STARA Awareness moderates the indirect effect of job crafting on the relationship between employee resilience and career satisfaction, such that the indirect effect on the relationship between employee resilience and career satisfaction is stronger among employees with greater levels of STARA awareness.

Overall, our conceptual research model is represented in Figure 1.

Figure 1. Conceptual Research Model



Source: Figure by the authors

3. RESEARCH METHODOLOGY

The model fit of the research variables was assessed using SPSS AMOS. The hypotheses were examined by the application of structural equation modeling (SEM) after the establishment of the measurement model for the sample. This study presents the reported values of the calculated standardized path coefficients and fit statistics. The evaluation of the structural model fit was conducted using statistical measures, such as χ^2 statistic, normed chi-square (χ^2/df) root mean square error of approximation (RMSEA), standardized root mean square residual (SRMR), and comparative fit index (CFI). The serial multiple mediation study employed bootstrapping with 5000 iterations (Williams & MacKinnon, 2008), a widely recognized and effective method for assessing indirect effects. Also, PROCESS Macro for SPSS was used for testing the moderator effects.

3.1. Participants

The present study uses a cross-sectional research design to gather data at a single point in time, employing self-report questionnaires as the primary method of data collection from participants. In total, 321 white-collar employees from various enterprises completed the survey forms. The participants were given a questionnaire containing the measuring instruments employed in the present study. Data collection was facilitated by the utilization of online forms via Google Forms. After reading the

summary of the study in the first segment, participants were guaranteed anonymity. The participants were requested to engage in the survey only voluntarily. The present work has obtained ethical approval from the host institution and adheres to the institutional guidelines for ethics and publishing. Regarding gender, 193 (60.1%) of them were female and 128 (39.9%) were male. In terms of the age of the participants, 59 (18.4%) of them were between 18 and 23; 92 (28.7%) of them were between 24 and 29; 69 (21.5%) of them were between 30 and 35; 32 (10%) of them were between 36 and 41; 33 (10.3%) of them were between 42 and 47; and 36 (11.2%) of them were 48 and above.

3.2. Measures

All variables were measured on a scale between 1 (Strongly disagree) and 5 (Strongly Agree).

Employee resilience. The 9-item “Employee Resilience Scale” developed by Näswall et al. (2019) measured employee resilience. A sample item is “*I resolve crises competently at work.*” The inter-reliability coefficient of the scale was 0.90 in the original study.

Job crafting. The 21-item “Job Crafting Scale” developed by Tims et al. (2012) measured job crafting. A sample item is “*I decide on my own how I do things.*” The inter-reliability coefficient of the scale was 0.82 in the original study.

STARA awareness. STARA Awareness was measured with a 4-item “STARA Awareness Scale” developed by Brougham and Haar (2018). A sample item is “*I think my job could be replaced by STARA.*” The inter-reliability coefficient of the scale was 0.85 in the original study.

Career satisfaction. Career satisfaction was measured with a 5-item “Career Satisfaction Scale” developed by Greenhaus et al. (1990). A sample item is “*I am satisfied with the success I have achieved in my career.*” The inter-reliability coefficient of the scale was 0.88 in the original study.

4. RESULTS

4.1. Descriptive Statistics

The descriptive statistics including the means, standard deviations, bivariate correlations between the study variables, and Cronbach’s alphas of the scales are shown in Table 1. All of the study constructs were significantly positive, and the correlations were above the threshold of 0.01. As seen in Table 1, employee resilience is positively related to job crafting ($r=.67, p < .01$) and career satisfaction ($r = .44, p < .01$). Job crafting has a significant positive relationship with career satisfaction ($r =.54; p < .01$). On the other hand, the variables are not statistically related to STARA. As seen in Table 1, composite reliability values of the scales are .90; .90; .91; and .91 respectively, which means reliability levels are higher than .70, therefore acceptable (Hair, 2009). According to Hair (2009), data is seen to exhibit normality when its skewness falls within the range of -2 to +2, and its kurtosis falls within the range of -7 to +7. The average values of the scales, namely 0.52, 0.51, 0.66, and 0.67, respectively,

demonstrate that they are above the acceptable threshold of 0.50 established by Fornell and Larcker (1981).

Table 1. Descriptives

Variables	Mean	SD	1	2	3	CR	AVE	Skewness	Kurtosis
1. Employee Resilience	4.23	.04				.90	.52	-1.39	2.12
2. Job Crafting	4.01	.04	.67**			.90	.51	-.76	.76
3. Career satisfaction	3.72	.05	.44**	.54**		.91	.66	-.46	-.24
4. STARA	2.27	.06	-.10	-.01	-.05	.91	.67	.72	-.40

Note. N= 321. CR: Composite Reliability, AVE: Average Variance Extracted **p < .01

Source: Table by the Authors

4.2. Testing the Mediating Role of Job Crafting

Before estimating the structural model, a measurement model was developed using the SPSS AMOS 21.0 software and the maximum likelihood technique using confirmatory factor analysis (CFA). To assess the distinctiveness of the research variables, four separate confirmatory factor analyses (CFAs) were conducted, as outlined by Bagozzi and Edwards (1998). The adequacy of the model was evaluated using many statistical measures, including the χ^2 statistic, normed chi-square (χ^2/df), RMSEA, SRMR, and CFI. According to Browne and Cudeck (1992), a value below .05 is indicative of a favorable fit for both RMSEA and SRMR. In addition, Hu and Bentler (1999) suggest that a value of .90 or above is considered appropriate for CFI.

Table 2. CFA Results for the Measurement Models

Model	χ^2	df	χ^2/df	p	RMSEA	SRMR	CFI
1. Four-factor model	751.455	311	2.416	.000	.06	.06	.93
3. Three-factor model	1150.515	321	4.939	.000	.11	.08	.81
2. Two-factor model ^a	2880.079	323	8.917	.000	.16	.20	.60
3. Two-factor model ^b	3037.228	323	9.403	.000	.16	.13	.56
4. One-factor model	3422.000	324	10.562	.000	.17	.13	.52

Note. N = 321. The four-factor model included employee resilience, career satisfaction, job crafting, and STARA awareness. The three-factor model comprised of employee resilience and job crafting collapsed into one factor, career satisfaction, and STARA awareness as separate factors. The two-factor model^a contained employee resilience and job satisfaction collapsed into one factor, and career satisfaction and STARA awareness collapsed into another factor. The two-factor model^b included employee resilience and STARA collapsed into one factor and job crafting and career satisfaction collapsed into another factor. In the one-factor model, all the constructs were collapsed into one factor.

Source: Table by the Authors

The results of CFA show that the four-factor model had a good model fit to the data with the following fit indices: χ^2 (751.455, N = 321) = 2.146, $p < 0.001$; RMSEA = .06; SRMR = .06 and CFI = .93). As an alternative model, the three-factor model included employee resilience and job crafting, which collapsed into one factor, career satisfaction, and STARA awareness as separate factors. The two-factor model^a included employee resilience and job satisfaction, which collapsed into one factor, and career satisfaction and STARA awareness, which collapsed into another factor. The two-factor model^b included employee resilience and STARA, which collapsed into one factor, and job crafting and career satisfaction, which collapsed into another factor. In the one-factor model, all the study variables were taken as one factor. Compared to other alternative models, the four-factor model had a better fit than the three-factor (χ^2 (321, N = 321) = 1703.218, $p < 0.001$; RMSEA = .11; SRMR = .08; and CFI = .81), two-factor^a (χ^2 (323, N = 321) = 2880.079, $p < 0.001$; RMSEA = .16; SRMR = .20; and CFI = .60), two-factor^b (χ^2 (323, N = 321) = 3037.228, $p < 0.001$; RMSEA = .16; SRMR = .13; and CFI = .56), and the one-factor model (χ^2 (324, N = 321) = 3422.0, $p < .001$; RMSEA = .17; SRMR = .13 and; CFI = .52) (Table 2).

Table 3. Results of the Structural Model

Path	DE	95% CI	IE	95% CI	TE	95% CI
Employee resilience → Career satisfaction (H1)	.12	[-.13,.35]			.45**	[.33,.55]
Employee resilience → Job crafting (H2)	.80**	[.72,.86]			.80**	[.72,.86]
Job crafting → Career satisfaction (H3)	.42**	[.18,.66]			.42**	[.18,.66]
Employee resilience → Job crafting → Career satisfaction (H4)			.33**	[.14,.54]		

Note. DE = Direct effect; IE = Indirect effect; TE: Total effect; CI = confidence interval.

* $p < .05$, ** $p < .01$. Model fit indices: $\chi^2 = 646.045$, $df = 220$, $\chi^2/df = 2.937$, CFI = 0.92, SRMR = .07, RMSEA = .07, $p = .000$

Source: Table by the Authors

The proposed research model was evaluated utilizing structural equation modeling subsequent to the execution of CFA. The results of the overall structural model, including direct, indirect, and total effects, are presented in Table 3. The results showed that the direct effect of employee resilience on career satisfaction ($\beta = .12$, $p > .01$) was found to be insignificant while employee resilience has a significant direct effect on job crafting ($\beta = .80$, $p < .01$). Thus, H1 was rejected and H2 was accepted. Also, the direct effect of job crafting on career satisfaction was significant ($\beta = .42$, $p < .01$). Hence, H3 was supported.

Using 5,000 bootstrap samples, all indirect effects have been assessed with 95% bootstrap confidence intervals. Table 3 shows that the indirect effect of the mediator, job crafting, on the relationship between employee resilience and career satisfaction ($\beta = .33$, $p < .01$) was significantly

positive. Thus, job crafting fully mediates the relationship between employee resilience and career satisfaction and H4 was supported.

4.3. Testing the Moderating Role of STARA Awareness

To test the moderating role of STARA awareness, PROCESS Macro (Model 8) for SPSS was used (Hayes, 2013). We tested the moderator role of STARA awareness between employee resilience and job crafting. Table 4 presents the estimates, standard errors, and bootstrap confidence intervals for the conditional effects of STARA awareness across low and high levels of employee resilience. Since the conditional effect of STARA awareness is statistically significant ($b = -.09$, $SE = .04$, $t = -2.19$, $p < .05$), H5 is supported. The illustration of the moderating role of STARA awareness is depicted in Figure 2. On the other hand, as seen in Table 4, the moderated-mediation role of STARA awareness was found to be insignificant ($b = -.04$, $SE = .03$, $t = -0.11$, $p > .05$), thus H6 is rejected.

Table 4. Moderator Role of STARA Awareness

Variable	b	SE	t	p	LLCI	ULCI
Mediator (Job Crafting)						
Employee Resilience	0.7362	0.0456	16.1142	0.0000	0.6465	0.8289
STARA Awareness	0.0372	0.0286	1.3011	0.1942	-0.0190	0.0934
Employee Resilience X STARA Awareness (H5)	-0.0926	0.0422	-2.1912	0.0282	-0.1757	-0.0095
			b	SE	LLCI	ULCI
Conditional direct effect						
M-1SD			0.8371	0.0655	0.7083	0.9659
M			0.7362	0.0456	0.6465	0.8259
M+1SD			0.6353	0.6353	0.5092	0.7615
Conditional indirect effect						
M-1SD			0.4291	0.0847	0.2777	0.6103
M			0.3774	0.0672	0.2521	0.5164
M+1SD			0.3257	0.0663	0.2066	0.4695
Index of moderated mediation (H6)			-0.0475	0.0327	-0.1178	0.0123

Source: Table by the Authors

Figure 2 shows the variance of the simple slope for employee resilience on job crafting at different levels of STARA. High-level awareness of STARA negatively affects the degree of the effect of employee resilience on job crafting. On the other hand, a low level of STARA awareness positively affects the degree of the effect of employee resilience on job crafting. Based on Figure 2, the lower STARA awareness has a slightly steeper slope than the higher group, which shows that STARA awareness has an increasing effect on the relationship between employee resilience and job crafting.

Figure 2. The Moderator Role of STARA Awareness



Source: Figure by the Authors.

5. RESULTS

This study investigated the role of job crafting in the relationship between employee resilience and career satisfaction. The results indicated that employee resilience is positively correlated with both job crafting and career satisfaction. This finding implies that employees who can cope with unexpected adversities at work could be more able to balance between their job demands and resources to face different challenges. Also, employees with higher resilience at work would experience higher levels of positive attitudes towards their careers. The present study's findings are consistent with previous research that demonstrates a correlation between resilience and career satisfaction (Srivastava & Madan, 2020). Thus, employees who possess resilience could experience higher levels of satisfaction with their careers.

Another finding of this study indicates that job crafting is positively related to career satisfaction. Employees who actively craft their jobs would possibly be more satisfied with their careers. The results obtained from the SEM analysis suggest that job crafting is a mediator, revealing the mechanism by which employee resilience has a favorable impact on career satisfaction as predicted. In other words, the extent to which employees can bounce back from challenges and setbacks has a direct effect on their overall fulfillment with their careers, and this effect is mediated by job crafting behaviors. Previous studies showed that job crafting served as a mediator in the relationship between mindfulness as a personal resource and resilience (Hur et al., 2023). Also, individuals who possess increased levels of psychological resilience tend to exhibit greater levels of positive affect. Consequently, this increased positive effect is associated with more commitment toward implementing favorable changes in the organization (Shin et al., 2012).

Another significant finding of this study is that STARA awareness moderates the relationship between employee resilience and job crafting. As STARA awareness increases the relationship between employee resilience and career satisfaction is weakens. The observed outcome can be attributed to Ding's (2021) argument that employees, may be concerned about their job insecurity, and losing autonomy because of the implementation of STARA. The implementation of STARA represents a shift in work practices, which introduces potential risks and uncertainties for both the job itself and the individuals. One of the most critical issues would be a decrease in employee resilience (Frey & Osborne, 2017; Tan et al., 2023; Tan & Yeap, 2022). Furthermore, this study demonstrated that individuals who possess resilience are more inclined to engage in job crafting when their STARA awareness levels are low. This finding is particularly significant given the extensive digitization of organizational activities. As prior studies showed, STARA and job crafting are correlated (Kang et al., 2023) showing that if employees are aware of smart technologies and their possible uses in the workplace, they could adjust themselves accordingly. In this study, STARA awareness items are associated with the fear that STARA would displace employees' job opportunities, so the STARA awareness as a threat by employees reduces the relationship between employee resilience and job crafting. Additionally, the moderating-mediator role of STARA awareness was found to be insignificant. This result may be linked to contextual or methodological factors mentioned in the limitations section. This study has also addressed the requirement of a new study by contributing to a new research model that examines the effect of STARA awareness on the relationship between employee resilience and career satisfaction.

This study presents several theoretical implications. First, the results highlight the need to incorporate individual resources, such as resilience, and proactive actions, such as job crafting, into existing organizational theories, such as the Job Demands-Resources (JD-R) model. This discovery contributes to our comprehension of the interplay between individual traits and adaptive approaches in influencing outcomes related to careers, hence providing a more comprehensive framework for examining employee satisfaction and effectiveness within organizational contexts. This study suggests that career satisfaction is positively affected by employee resilience and this relationship is mediated by job crafting. Also, this study provided evidence that the relationship between employee resilience and job crafting is moderated by STARA awareness. The study findings imply that employees with higher STARA awareness may experience lower levels of job crafting. However, employees who craft their jobs may be more aware of and competent in the use of smart technologies. Through the examination of these two concepts together, an opportunity arises to investigate potential complementary connections or interdependencies, therefore revealing their collective impact on individuals' career satisfaction. Currently, it is extremely difficult to analyze employees' perspectives on their careers without considering the impact of digitalization. Hence, the primary finding of this study is the identification of job crafting as a functional mechanism for adapting to evolving workplace demands, and its impact on individual career satisfaction. Additionally, the moderating effect of STARA awareness between

employee resilience and job crafting can be explored in future studies in relation to the theory of technology acceptance. Examining STARA through different measurement approaches, in terms of job insecurity and career sustainability, could provide valuable insights for both employees and organizations.

This study also highlights noteworthy practical implications. Given that career satisfaction is a significant cognitive and affective construct about one's job, it is influenced by both employee resilience and job crafting behaviors. Consequently, organizational interventions may be proposed to address these factors. Organizations could allocate resources towards resilience-building initiatives, which aim to provide employees with the necessary skills and mindset to effectively recover from setbacks (Kuntz et al., 2016). The practical implications of the findings indicate that professionals in the field of industrial psychology, as well as those in career and human resource management, should evaluate the extent to which employees possess resilience. Based on this assessment, they should then create career development programs and counseling interventions that promote the development of employee resilience, thereby facilitating the effective utilization of employee adaptability and job crafting behaviors (Coetzee et al., 2023). Moreover, employees who craft their jobs are more likely to pursue their careers in ways that allow them to communicate their career objectives, beliefs, and inspirations, resulting in a better person-organization fit (Kim & Beehr, 2018). Thus, organizations can incorporate evaluations of resilience and job crafting into their performance assessment and goal-setting procedures for internalization of organizational goals and a better fit. This can assist individuals and supervisors in recognizing possible paths for individual advancement and professional development. Creating a workplace environment that fosters creativity and adaptability has the potential to enhance the practice of job crafting as well as positive career outcomes.

There are certain limitations to this study. It is essential to recognize that convenience sampling is associated with several limitations, including the potential for selection bias and limited generalizability. Utilizing a wider range of diverse and cross-cultural samples can lead to the attainment of results that are more generalizable. Furthermore, this study did not consider all potential environmental and individual variables. Also in future investigations, the utilization of a longitudinal data-gathering technique has the potential to yield more insightful results. It is important to emphasize that the variables incorporated into the model created in this research are entirely subjective. In future studies, the mediating role of job crafting on the effect of employee resilience on outcomes such as work engagement (Malik & Garg, 2020), well-being (Tonkin et al., 2018), and organizational commitment (Paul et al., 2016) could be examined. Other mediators could be taken into consideration other than job crafting to explain the mechanisms between employee resilience and career satisfaction such as job embeddedness (Eslamlou et al., 2021), career adaptability (Topino et al., 2022) or employability (Rossier et al., 2017). Future research could investigate employee resilience at the team level by considering collective job crafting. Resilience and job crafting may also have potential contributions to

performance at individual and team levels (Luu, 2017) which, could yield important outcomes for organizational success. Moreover, there are differences in employees' attitudes towards technological innovations (Morikawa, 2017). It is important to understand how employees and managers perceive the implementation of artificial intelligence (Im & Kim, 2022), smart technology, robotics, and algorithms to make their attitudes about these technologies positive for adapting to the new environment and maintaining employee resilience and career satisfaction.

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Examination of Business People's Attitudes Towards Virtual Trade Fairs *

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Abstract

The digitalization trend in the business world and the mandatory conditions that originated from COVID-19 increased the importance of virtual fairs. Determining the direction of attitudes of the business people, who participated in virtual fairs, will allow for having an idea about the future of these fairs. In addition, it is also essential to determine which company characteristics are associated with these attitudes. However, there are only few studies in the literature about virtual fairs, which have recently gained much importance. In this research, which aims to contribute to the literature, an online survey was conducted on 204 business people that participated in at least one virtual trade fair in 2022. The data collected was analyzed by using Exploratory Factor Analysis, K-means Clustering, and Chi-Square Test. The results showed that the firms generally have positive attitudes. The dimensions of these attitudes are related to the perceived usefulness of the Technology Acceptance Model. However, given the results of the Exploratory Factor Analysis, the items that represented the perceived ease of use are not effective. When the relationships between business characteristics and business people's attitudes towards virtual trade fairs were tested and no statistically significant relationship was found between the business's age or the business's size and attitudes. The only statistically significant relationship is the one between business people's judgment on the industry's suitability of the business and their attitude towards virtual trade fairs.

Keywords: *Virtual trade fairs, Attitude, Digitalization, Technology Acceptance Model.*

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1. INTRODUCTION

Digitalization changed the scope and pace of business activities. Thanks to the faster and easier transfer of values, it created new ecosystems for change and also helped businesses connect and consumers worldwide more easily (González & Ferencz, 2018). Digital technologies (a combination of information, computing, and communication technologies) radically transform business strategies, business processes, business capabilities, products, and services, and also enhanced business relationships (Bharadwaj et al., 2013).

Even though face-to-face communication has been an essential component of trade for centuries, time and cost concerns shifted communication channels to virtual alternatives. The COVID-19 pandemic accelerated this process. Digital technology drew increasingly more interest due to the changing economic conditions of the world and the expectations of businesses during the pandemic period. Because the COVID-19 pandemic forced many businesses and individuals to move from a predominantly physical world into a potentially temporary and digital one (Schneider & Kokshagina, 2021). However, mandatory changes in business activities might become preferable after the pandemic. For these virtual activities to be permanent, the business world must adapt to these activities and attain positive attitudes in parallel with their benefits. Otherwise, the previous conditions will return when the mandatory conditions are removed.

Trade fairs are one of the business activities affected by digital transformation and shifted remarkably to virtual environments during the COVID-19 pandemic. As a concept, a trade fair refers to "a planned event where manufacturers, distributors, and other vendors exhibit their products or promote their services to guests, including current and potential customers, suppliers, other business partners, and the press" (Bonoma, 1983). Especially the international ones, continue to function as early heralds of change and transformation in every field worldwide. On the other hand, virtual trade fairs are those: *'held in cyberspace, where all types of organizations (from small to large) use computer-mediated information technology (IT) with web-based capability can participate'* (Gani et al., 2021: 288).

As Lacka et al. (2020) revealed in their bibliometric analysis covering 50 years, "there is a scarcity of empirical studies examining technological advancements and B2B activities at international level, as well as local". In addition to this literature gap, virtual trade fairs are a relatively new phenomenon, and there is an ongoing debate about whether they will replace physical ones in the future (Lee-Kelley et al., 2004). So, the first motivation of this study is to create a vision regarding the future of virtual trade fairs in post pandemic period. The companies' receptivity to virtual trade fairs and their scope are questions to be addressed, in this context. Moreover, scientific research is cumulated in the Western world. Developing countries like Türkiye are still behind the Western world in researching this topic (Sarmiento & Simoes, 2018). Origin of the research is important because attitudes are shaped under the shade of culture. Asian trade fairs take a more relational approach than Western counterparts' transactional tendencies (Li & Ze, 2024).

Critical questions still need to be answered, such as how business people perceive and embrace virtual trade fairs. These attitudes will determine the post-exhibition purchases and the next visits. These emerge as signals of an exhibition's performance in relation to visitors' perception. Besides, especially when visitors' long-term motives meet their participation goals, they will tend to confirm participation at the next edition of the event (Vitali et al., 2022). Kourkouridis et. al (2024) tried to answer this question in their research. However, the sample used, consisted of only 26 companies that attended at a virtual trade fair before. Consequently, the attitudes measured relied on the unexperienced business people and because of the sample restriction, analysis depend on graphics.

Another gap in virtual trade fair literature is that more research is focusing on differences among company characteristics and industries (Sarmiento & Simoes, 2018). The present study aims to measure the attitudes of experienced Turkish business people towards virtual trade fairs and determine which business qualifications these attitudes relate to. Firstly, the findings will give some managerial insights regarding the future of these events. Some insights are supposed to answer questions such as: Will businesses continue participating in those events after the pandemic? Should fair organizers continue promoting these activities? In which areas can these events be improved? Secondly, the study will contribute to the academic literature, focusing on "virtual fairs" for the first time under the lights of technology adoption models. The wide range of sectorial scales in the sample may inspire new sectorial research.

The rest of this paper is organized as follows. In section 2, the past research related to virtual trade fairs, their comparison with physical ones, their future, and the theoretical background of the research are covered. Section 3 comprehensively outlines the methodology.

2. LITERATURE REVIEW

2.1. Virtual Fair as a Digitized B2B Event

Nowadays businesses face rapidly evolving changes and complexities that challenge their management structures and capabilities. Especially digitalization, which refers to using digital technologies to change a business model and provide new income/value generation opportunities or transition to a digital business (Gartner, 2018), has been one of the essential drivers of the new economy. This transformation is more prominent particularly in marketing communication because communication has shifted to digital and virtual fields and local and international face-to-face communication has decreased further (Silva & Elo, 2019).

The concept of "virtual event" refers to a business event or activity that connects two or more parties via technology. These events played a crucial role in business life during the COVID-19 period. While the restrictions caused by the COVID-19 pandemic significantly limited and affected the work of scientists and communicators, the pandemic has also encouraged the development of new networking and public engagement methods. People have adapted to virtual events together with the popularization

of webinars, online meetings, and digital resources (Munzi & Giovanetti, 2021). Roos et al. (2020) stated that virtual events, especially virtual conferences, are increasingly becoming a new reality. Similarly, Cardon et al. (2021) emphasized that the number of daily virtual meeting participants increased from 10 million to 300 million between January and April 2020 and the platforms supporting these meetings also grew. For example, Microsoft Teams grew from 50 million daily users to 145 million between 2019 and 2020.

The number of virtual events increases for several reasons. Virtual events and trade shows can be managed online, virtually eliminating the cost of travel, accommodation, and trade fair activities. Virtual events also create a smaller carbon footprint. Finally, this reduction in travel reduces the risk of downtime due to absenteeism (Pearlman & Gates, 2010).

Trade shows have traditionally been one of the best ways to enter or find a new market. Thanks to the fairs, businesses convey their messages regarding their products to many potential buyers simultaneously. In addition, they can gather information about the conditions of competition. From this perspective, a trade fair is an exhibition held for businesses operating in a particular industry to exhibit their new products and services and also examine and discover their competitors' activities (Palumbo, 2012).

Businesses can participate in fairs for various objectives and benefits. Those objectives include launching and introducing new products to potential customers (Shereni et al., 2021), gathering information about technological and strategic choices of competitors, suppliers, and customers (Bathelt & Spiegel, 2012), developing brands, accessing to global customers, and enhancing relations with existing customers.

It can be seen that trade fairs and trade shows are used interchangeably in the literature. Gottlieb and Bianchi (2017) define a virtual trade fair as: "A virtual trade show is a type of virtual event, where exhibitors and visitors connect with one another via a virtual environment (Internet), regardless of geographic location, to interact and exchange information." Geigenmuller (2010), on the other hand, defines virtual trade fairs as multimedia web-based platforms, where customers, suppliers, and distributors can meet virtually anytime and anywhere and where the interactions consist of textual, visual, and acoustical components. The virtual trade fair is still very new as a concept and, as with many innovative technologies, it would take some time for those fairs to draw intense attention.

However, the COVID-19 pandemic increased businesses' speed of gaining experience in this field. In that period, virtually organizing the fairs was the only alternative to canceling physical fairs. Center of Exhibition Industry Research (CEIR) (2021) stated that 71% of the organizers, who had to postpone their planned events during the COVID-19 period to 2021 and later, continued their activities by offering hybrid alternatives until 2021.

Willingly or by necessity, many business people participated in virtual trade fairs with the expectation of adding value to their businesses. The benefits expected from virtual trade fairs are similar to traditional ones. Businesses participate in virtual fairs to increase sales revenue, reduce costs, gain access to new or different markets, and build brand reputation and corporate legitimacy among visitors (Gottlieb & Bianchi, 2017). Similarly, Vik et al. (2018) stated that the benefits of virtual fairs include visibility and branding, low costs, and analytics-based customization. In addition, more precise tools, such as gradual access permissions, distinguish between less qualified visitors, senior customers, and prospect buyers (Geigenmuller, 2010). Despite the overlap between expected benefits, there also are some researchers considering virtual fairs as a complement to traditional fairs rather than an alternative. Sarmiento and Simoes (2019) argued that while virtual trade shows are an instrument for personal interaction with people as in physical trade fairs, they function as a catalyzer to promote interaction and connection before and after physical trade fairs.

2.2. Virtual Fairs Versus Physical Trade Fairs

As stated in the Innovation Adoption Model, business people tend to evaluate the advantages/disadvantages of the recent technology relative to the old one. It is essential to compare the physical and virtual trade fairs from the perspective of participants. Although the expectations from virtual fairs overlap with those from physical fairs, there are differences between the two regarding information flow and communication. The following comparison created by Bathelt and Schuldt (2010) reveals the advantages and disadvantages of physical and virtual fairs quite well.

As seen in Table 1, although information and communication technology utilized in virtual fairs has many disadvantages when compared to physical fairs, it also offers a few advantages. These advantages are related with convenience and access, whereas there also are disadvantages regarding relationship depth and focus.

As stated by previous researchers, providing access to busy business people attending virtual fairs at any time and the simplicity of finding and searching for the correct information are the factors making these events attractive. Pecherskaya et al. (2019) also emphasized the access and conveniences of virtual trade fairs. However, due to the ease of access, participants differing from the usual participants of physical fairs might gather in virtual fairs, which is considered to be a negative aspect. The focus brought by spatial unity is weaker in virtual fairs. The attendance of participants in the virtual fair while fulfilling their daily work routines negatively affects the communication process. Another factor that negatively affects the communication process is the limitedness of nonverbal communication components in virtual fairs. Considering the importance of nonverbal communication in contextual cultures, it is obvious how this disadvantage in virtual fairs can negatively affect communication.

Bathelt and Schuldt (2010) compared virtual and face-to-face fairs in terms of information and communication. However, it should be noted that virtual fairs can be more advantageous in terms of

cost and practicality. Virtual fairs can be considered to be a good alternative for a business that cannot participate in a physical fair due to time and financial constraints. The benefits of virtual fairs for SMEs might be more than the others.

Table 1. Comparison between Physical and Virtual Fairs Regarding Relationship Development

Global buzz during international trade fairs	Virtual buzz during virtual trade fairs
Global co-presence	
(+) High level of participation from different countries	(+/-) No requirement for the physical presence
(+) Unique business networking environment	(+) Ability to get fast and plain impressions about products/firms
(+) Participants share commitment and patience	(+) Ability to access all the time
(+) Daily routines rarely interrupt the process	(+) High connectivity for agents in isolated locations
(+) Critical self-reflection	(-) Scattered participants
(+/-) High accessibility of exhibitors	(-) Daily routines interrupt the virtual activity
Face-to-face interaction	
(+) Usage of non-verbal communication tools	(+) Ease of focused communication for existing partnerships
(+) Ease of conveying complicated messages and quick feedback	(-) Lack of eye-contact
(+) Decentralized information flows	(-) Hidden identities/intentions/agendas
(+) Permanent evaluation and re-evaluation of news	(-) Not sharing sensitive information for security concerns
(+) Reduced risks in establishing future partnerships	(-) Minimum sensible relations
Observation	
(+) In situ observation: inspection/“touch and feel”	(+) Ability to observe the web activities of participants
(+) Ability to observe the reactions of other participants	(-) Designs/products can only be imagined, not experienced
(+) Ability to visualize the competitors’ positions	(-) Evaluation/interpretation as an isolated process
(+/-) Being reachable and meetable	
Focused communities	
(+) Diversity of practitioners and other participants who have other purposes	(+) Probability of randomly colliding with unrelated sectors
(+) Complementary/conflicting know-how bases	(-) Accessibility is more difficult for newcomers
(+) Ability to conduct high-quality business relationships	(-) The presence of a critical global scale company participant at any time is rare.
(+) Combined evaluations help individuals to decide	
(-) Existence of closed communities	
Multiplex meetings and relationships	
(+ /-) Variety of scheduled/unscheduled meetings	(+/-) A goal-dedicated approach
(+) Close relationships established with different participants	(+/-) Limited number of bilateral relations
(+) Effective feedback opportunity	(-) Risk of missing out on important possible partners
(+) Initial trust can be developed quickly	(-) Difficult to give and receive feedback
(+) Multiple channels derive from face-to-face contact	

Source: (Bathelt & Schuldt, 2010).

2.3. The Future of Virtual Trade Fairs

It is unknown if virtual trade fairs will be organized after the pandemic as frequently as during COVID-19. As stated by the World Bank, virtual tools including fairs are expected to increase after the pandemic. Trade Promotion Organizations plan to expand the use of all the virtual programs put in place

as COVID-related restrictions ease (Choi et al., 2023). However, the report focuses only on virtual fairs, not the hybrid ones. Porpiglia et al. (2020) proposed that human and technology should be combined. To achieve this objective, the unlimited potential of the digital world should be gradually integrated into the real world and open its doors to "hybrid" events. In other words, face-to-face activities should be combined with virtual activities. Thus, participants can enjoy the virtual content provided and interact with it in real-time. Therefore, hybrid alternatives should be considered rather than solely virtual and physical fairs.

The benefits, which businesses derive from previous virtual trade fairs, will determine their intention to participate in such events in the future. However, it should be determined if virtual fairs will be considered as an alternative or a complement to physical fairs or a completely different digital marketing tool. Moreover, technological advancements will continue, and the structure of virtual events will evolve. These changes also will shape future attitudes.

Investigating the virtual fair experiences of the participants and their future predictions, The Global Association of Exhibition Industry (UFI, 2022a) carried out a survey study on participants from more than 30 countries in the year 2020. The survey included questions addressing the disadvantages of virtual trade fairs and how they affected business people from personal and professional aspects. Given the results achieved, it was determined that face-to-face events are still strong as a core value and there is no evidence suggesting a long-term shift from live events.

UFI (2022b) repeated the same study when the effects of COVID-19 decreased, and normalization started. The survey results completed in February 2022 and July 2022 are as follows:

Table 2. UFI Global Barometer Statistics Related to the Format of Future Trade Shows

Statements	% of the participants who agree with the statement	
	February 2022	July 2022
COVID-19 confirms the value of face-to-face events - the sector bounces back quickly	80	87
Less international "physical" exhibitions, and overall, fewer participants	44	31
A push towards "hybrid" events, more digital elements at events	73	61
Virtual events replacing physical events	11	5

In this 6-month period, when the return to the old order accelerated after the decline in COVID-19 cases, the participants' predictions evolved from virtual to physical fairs. However, the expectations for hybrid events are quite positive. Although the participants think virtual fairs cannot replace physical fairs, they anticipate that the conveniences offered by digitalization can be integrated into physical fairs. Based on these views, virtual and physical fairs can be considered to be promotional tools with complementary elements rather than alternatives to each other.

As stated by Gottlieb and Bianch (2017), the future of virtual fairs will depend on the technological evolution of virtual exhibition systems and how they are integrated into existing

technological and strategic business processes for exhibitors and visitors. It can be expected that advancements such as the spread of 5G technology and the use of Metaverse for exhibition facilities would expand the interaction area of virtual exhibitions.

2.4. Theoretical Background on Acceptance and Adoption of New Technologies in the Context of Virtual Fairs

In the literature, there are different theoretical approaches to explaining digital activities. However, within the context of this study, which includes the approach to virtual fairs, the following three theories are discussed: the Theory of Planned Behavior, the Diffusion of Innovations Theory, and the Technology Acceptance Model.

Azjen's (1991) Theory of Planned Behavior (TPB) suggests that attitudes are one of the determinants of future actions. How did those business people evaluate their experiences and what attitudes do they have towards those fairs? The answers will be useful in predicting the future actions of those business people. Did they adopt the virtual fairs, or will they abandon them? Theories aiming to discover the factors influencing this decision will help to find the answers.

In Rogers' (1976) Diffusion of Innovations (DI) Theory, it is emphasized that there are five stages of the innovation-decision process: (1) awareness, (2) developing an attitude, (3) adopting or rejecting, (4) decision to use (5) reinforcing and institutionalizing the innovation-decision. In the case of virtual fairs, it wasn't an option to reject the digital way of doing business because, in that period, there was no alternative to this method. Due to this obligation, many businesses participated in virtual fairs, and most of them had their first experiences in those fairs. However, it is not clear if these companies would participate in those events when the pandemic is over. So, in the context of the innovation-decision process, the first stages are covered speedily. After their experiences, the businesses will decide to reinforce or abandon when the pandemic is over. Furthermore, it was revealed that participants' engagement regarding hybrid fairs and perceived compatibility positively affected their loyalty to these events (Silva et al., 2023). Attitudes, in this regard, are the antecedents of engagement.

The Technology Acceptance Model (TAM) is considered to be the most influential and commonly employed theory for describing an individual's acceptance of information systems (Lee-Kelley et al., 2004). In this theory, it is emphasized that the acceptance of information systems depends on "perceived usefulness and perceived ease-of-use" (Davis, 1989). It defines perceived usefulness as "the degree to which a person believes that using a particular system would enhance his or her job performance." Here, usefulness is defined as "capable of being used advantageously." When developing this model, Davis (1989) criticized Innovation Adoption Model, which was developed by Tornatzky and Klein (1982). Their model suggests that the innovations' compatibility, relative advantage, and complexity have the most consistent and significant relationships to innovation adoption. Both models specified the advantages of the new technology as a determinant of acceptance. However, Innovation Adoption Model defines these advantages relatively. Perception and attitude towards the new

technology are defined in the users' minds by comparing the advantages of the new technology with the old one.

Although these models are widely employed, variables of TAM consistently explain 40 percent of the variance in individuals' intention to use (acceptance) and subsequent implementation (adoption) of a technology (Autry et al., 2010). TAM-based empirical studies did not yield consistent or clear results; hence, significant factors needed to be identified and included in the models (Legris et al., 2003). Some of these factors are experiences related to the technology (Davis & Venkatesh, 2004), environmental and organizational factors (Gangwar et al., 2014) such as company size, innovativeness of the firm, level of technology readiness, security, and trust (Wu, 2011). The experiences related to a specific technology (such as using prototypes) are significant predictors of usage intentions and behavior (Davis & Venkatesh, 2004).

Virtual trade fairs, which are products of information technologies, were new for most businesses until the COVID-19 pandemic. So that the adoption or the acceptance of virtual trade fairs can be evaluated by using the models of Technology Acceptance and Innovation Adoption models, together with the new extensions proposed by researchers.

Although TAM applies to many information technologies and software (Marangunić & Granić, 2015), no research could be found on virtual fairs because businesses participated with or without developing an attitude toward virtual fairs during the COVID-19 period. Nevertheless, they experienced those fairs, and those experiences will have predictive power in determining their future behaviors. These attitudes and some of the organizational factors might provide insights into the theory-building efforts of future research.

2.5. Hypotheses

Lee-Kelley et al. (2004) investigated to what extent virtual fairs support the marketing mix elements in their study. They conclude that, while there was a general agreement that there is a beneficial environment for "product," "promotion," and "price," the consensus on "location/distribution" was not that strong. This finding regarding the "place" might be related to their participation in virtual fairs solely to convey information and provide communication. Industries, for which physical contact or product display is vital, might be affected more than others due to this disadvantage of virtual fairs. In other words, while some sectors might be more active in virtual fairs, some cannot be because of a higher degree of need for a detailed examination of the product or establishing trust. However, as an interesting finding in the same study, it was revealed that jewelry companies were more willing to participate in virtual fairs than oil companies. However, jewelry is a product group that needs to be supported by more concrete elements than petroleum. This finding is consistent with King and Gribbins's (2002) research. They claimed that the individual-based technology acceptance model might not fit company-wide technology adoption. Their findings suggest that industry types, product types, and company sizes might

affect the technology adoption of the companies. In a qualitative research study carried out by Duman and Ecevit (2021), it was reported that sectors that are suitable for virtual fairs are informatics, games, education, books, stationery, tourism, real estate, and machinery. However, the sample of their study was fair organizers rather than participants. Based on the results of these studies, it can be seen that the attitude towards virtual fairs might vary depending on the industry, and the H_1 hypothesis is as follows:

"H₁: There is a relationship between the business people's judgment about the suitability of their industry and their attitude towards virtual fairs."

In a few academic studies examining firm behavior towards innovation and digitalization, firm age was considered as a variable. These studies also reported quite different findings. For instance, the results of the research conducted on exporting businesses located in Balıkesir and Bursa suggested that the evaluations of businesses in terms of marketing innovation did not differ according to the age of the businesses (Bıçımveren, 2017). In another study, Aydın et al. (2019) argued that experienced businesses can avoid investing in new technologies by creating more social networks when compared to younger ones. Therefore, being experienced can be a disadvantage considering the information system practices. However, Zimmerman (2018) determined that the probability of completion of digitalization projects is almost twice as high in older businesses as in younger businesses. They stated that "The likely reason is that older businesses, in particular, need to keep up with the digital environment more often. By contrast, start-ups are probably starting out with a higher level of digitalization already". In line with these studies, hypothesis H_2 is as follows.

"H₂: There is a relationship between business people's attitudes towards virtual fairs and the age of businesses they work in."

Along with the ease of use and relative benefits of the technology, organizational structure also may impact technology acceptance (Gangwar et al., 2014). In a study conducted by Eren (2017), it was determined that large enterprises are in better positions in comparison to small and medium-sized enterprises in terms of accessing the opportunities offered and using these opportunities effectively. As the business scale gets smaller, the number of cooperation and external links decreases. On the other hand, King and Gribbins (2002) claimed that the decision to adopt a technology might become more complex in larger organizations. Similarly, another research carried out in the United Kingdom showed that smaller businesses use e-commerce to a greater extent when compared to their larger counterparts. Smaller businesses believe that they have benefited more significantly from their e-commerce services than larger firms (Daniel & Grimshaw, 2002). As a result, it is not clear if the size of a business is a significant issue (Premkumar, 2003). These ambiguous findings show that more empirical tests should be conducted on this issue. Thus, the next hypothesis is as follows:

"H₃: There is a relationship between business people's attitudes towards virtual fairs and the size of the businesses they work in."

3. METHODOLOGY

The research population consists of enterprises in Türkiye that participated in at least one virtual fair between 2020 and 2021. In order to reach these businesses, 1067 businesses participating in the digital B2B fair organized by the Turkish Arab Cooperation Association were targeted. This fair was selected deliberately because it involved many businesses operating in different industries. To reach a maximum number of observations, all units that volunteered to participate in the research are included in the sample. So that both judgmental and convenience sampling methods are used. 204 of those businesses volunteered to participate in the research. Although the number of the participants of the present study is more than the previous related research, the sectorial range was not homogenous, all the participants were from Türkiye, and the participants were selected from the list of the attendants of one specific fair. In addition, these participants' virtual fair experiences might have been affected by the devices, by which they had connected to the event. These restrictions may have negative effects on the generalization of the results.

Quantitative methods were used in the research. Because of the ongoing COVID-19 pandemic, it was not possible to get in-depth opinions from the participants. Since it is participant-oriented research and there is no opportunity to collect in-depth data, an online questionnaire was used as a data collection tool. No quantitative scale designed for the measurement of the attitudes of participants towards virtual trade fairs could be found in the literature. Due to the lack of a previously developed scale, the qualitative scales and quotations of the limited number of studies in the literature were examined. A scale with Likert Type statements is formed by combining the questions of Lee-Kelley et al. (2004), Ling-yee (2010), Sarmiento and Simoes (2019), Duman and Ecevit (2021) and also the reports of The Global Association of Exhibition Industry (UFI) which articulated the Covid-19 experience. A pilot study was conducted with 40 participants and the items in the scale were improved. The final scale consists of three parts: (1) items describing the business, (2) items related to the attitudes toward virtual fairs, and (4) items about future expectations for virtual fairs. The data obtained in the research were analyzed by using the statistical package program after data extraction.

4. ANALYSIS AND RESULTS

4.1. Descriptive Statistics

Before the statistical analysis, the frequency and percentage distributions of the descriptive characteristics are given to see the general profile of the sample in Table 3.

- Most of the businesses are well-established enterprises in terms of the year of establishment.
- Although the businesses are distributed widely in terms of the industry they operate in; food and building/construction are dense.
- The business people from whom data is collected can represent the business.
- It can be seen that small and medium-sized enterprises dominate the sample.

Table 3. Descriptive Statistics of the Participants

		f	%		f	%
Age of Business	< 10	46	22.5	Food industry	53	26
	10-19	62	30.4	Building and Construction Materials	36	17.6
	≥20	96	47.1	Machinery and Parts	26	12.7
Number of Employees	>50	111	54.4	Furniture and Forest Products	17	8.3
	50-100	32	15.7	Textile and Apparel	12	5.9
	>100	61	29.9	Ferrous and Non-Ferrous Metals	10	4.9
Frequency of Participation in International Trade Fairs	1	91	44.6	Agriculture and Livestock	10	4.9
	2	37	18.1	Services	8	3.9
	>2	76	37.3	Cement, Glass, Ceramics, and Soil Products	5	2.5
Frequency of Participation in Virtual International Trade Fairs During COVID-19	1	133	65.2	Chemicals	5	2.5
	2	36	17.6	Electrical and Electronics	4	2
	>2	35	17.2	Home textiles	3	1.5
Title of Participant	Company Partner	76	37.3	Leather, Shoes, Bags	1	0.5
	General Manager	23	11.3	Coal	1	0.5
	Marketing/Sales Manager	34	16.7	Automotive and Parts	1	0.5
	International Trade Manager	57	27.9	Other	12	5.9
	Other	14	6.8			

4.2. Dimensions of Scale

Factor analysis operates on the notion that measurable and observable variables can be reduced to fewer latent variables that share a common variance and are unobservable, which is known as reducing dimensionality (Bartholomew et al., 2011). Principal Components analysis is used to extract maximum variance from the data set with each component thus reducing a large number of variables into smaller number of components (Tabachnick & Fidell, 2007). Principal Components Factor Analysis was conducted in order to determine the dimensions of the scale used in this research. The results obtained by performing orthogonal (Varimax) rotation are transferred by using tables. The Kaiser-Meyer-Olkin (KMO) criterion was used in assessing the consistency of the data. Cronbach Alpha analysis was conducted in order to determine the reliability of the scale.

Subjecting all 21 items were to factor analysis, a five-dimensional solution explaining 68% of the variance was achieved (KMO = 0.869). However, as a result of rotational factor analysis, it was observed that some items had factor loads close to each other in more than one dimension. These items are: “Less time is required to be prepared for the virtual fairs.” and “In virtual fairs, it is possible to face technical problems.”, “It is more difficult to obtain market intelligence in virtual fairs.”

The analysis was repeated by removing these items sequentially. The optimum solution was achieved by using 17 variables and 61.893% total variance was explained (KMO =0.865 and Cronbach Alpha =

0.847). The items under each dimension are examined. The first dimension is the "advantages dimension", the second dimension is the "short-term disadvantages dimension", and the third dimension is the "medium/long-term disadvantages". While the short-term disadvantages dimension mainly includes the constraints encountered before and during the fair, whereas medium/long-term disadvantages include the disadvantages related to issues such as efficiency that may be encountered after the fair. The details of the analysis are given in Table 4.

Table 4. Exploratory Factor Analysis of Attitudes Toward Virtual Trade Fairs Scale

	Factor Load	Variance Explained (%)
Factor 1 – Advantages		
1. Virtual fairs are suitable platforms for accessing new or distant markets.	0.889	
2. A wide variety of digital communication channels is an essential advantage of virtual fairs.	0.877	
3. Virtual fairs are convenient environments to gain new customers.	0.85	
4. Virtual fairs are suitable environments for the promotion of existing products.	0.85	36.05
5. Virtual fairs offer opportunities for small businesses that want to reach the global market.	0.843	
6. Virtual trade shows provide a unique environment for promoting new products.	0.831	
7. Exhibitors and visitors can access virtual fairs anytime, anywhere.	0.79	
8. Increasing brand awareness and credibility is easier in virtual fairs.	0.774	
9. With virtual fair technology, it is possible to eliminate visitors with lower potential.	0.668	
Factor 2 – Short-term disadvantages		
10. Virtual fairs are overpriced compared to the service offered by the organizers.		
11. Most exhibitors and visitors include the younger generation due to the digital adaptation problem in virtual fairs.	0.729	14.20
12. The lack of rules and standards is a fundamental problem with virtual fairs.	0.706	
13. It is possible to encounter virtual rudeness in the communication channels of virtual fairs.	0.698	
Factor 3 – Medium/Long-term disadvantages		
14. The return rate after virtual fairs is less than physical fairs.	0.783	
15. It is difficult to measure the effectiveness of virtual fairs.	0.699	11.65
16. There is no security risk in virtual fairs.	0.599	
17. The lack of physical contact is the most crucial disadvantage of the virtual fair.	0.554	

4.3. K-means Clustering Analysis

Clustering or grouping is done on the basis of similarities or distances, and it is one of the best approach of multivariate analysis and a common methodology for statistical data analysis (Oti et al., 2021). K-means is a partitional clustering method. It is commonly used in academic research due to its easiness, simplicity, and efficiency. Because of these advantages, this clustering technique was preferred in this research. K-means Clustering Analysis was conducted by using factor loads obtained from the Exploratory Factor Analysis to divide the sample into clusters in line with their attitudes. At eleven iterations, optimum clusters were found. Convergence was achieved due to no or small changes in cluster centers. The maximum absolute coordinate change for any center was less than 0.001. The minimum distance between initial centers was 6.869. The center point of the first of the two groups formed is 0.43462. The number of business people in the first group is 158, and the number of participants in the second group is 46.

Table 5 shows the averages of the answers given to the questions by the entire sample and the first and second clusters. The scale is a 5-point Likert scale; It should be noted that it is coded as “1=Strongly Disagree....5=Strongly Agree”.

Table 5. The general and cluster-based averages

	1. Cluster (n=158)	2. Cluster (n=46)	Sample (n=204)
Virtual fairs are suitable platforms for accessing new or distant markets.	3.62	1.93	3.24
Virtual fairs are suitable environments for the promotion of existing products.	3.61	1.98	3.24
Virtual trade shows provide a unique environment for promoting new products.	3.52	1.89	3.15
Virtual fairs are suitable platforms for accessing new or distant markets.	3.92	1.98	3.48
A wide variety of digital communication channels is an essential advantage of virtual fairs.	3.81	2.07	3.42
Increasing brand awareness and credibility is easier in virtual fairs.	3.39	1.87	3.05
Virtual fairs offer opportunities for small businesses that want to reach the global market.	3.92	2.17	3.53
Exhibitors and visitors can access virtual fairs anytime, anywhere.	4.08	2.5	3.72
With virtual fair technology, it is possible to eliminate visitors with lower potential.	3.53	2.24	3.24
The return rate after virtual fairs is less than physical fairs.	3.45	3.52	3.47
It is difficult to measure the effectiveness of virtual fairs.	3.17	3.15	3.17
There is no security risk in virtual fairs.	3.13	2.8	3.06
The lack of physical contact is the most crucial disadvantage of the virtual fair.	3.78	3.7	3.76
It is possible to encounter virtual rudeness in the communication channels of virtual fairs.	3.28	3.07	3.23
The lack of rules and standards is a fundamental problem with virtual fairs.	3.55	3.54	3.55
Virtual fairs are overpriced compared to the service offered by the organizers.	3.15	3.48	3.22
Most exhibitors and visitors include the younger generation due to the digital adaptation problem in virtual fairs.	3.51	3.37	3.48
Virtual fairs are not suitable for our industry.	2.58	3.52	2.79
Interest in virtual fairs will decrease after the COVID-19 Pandemic.	3.06	3.59	3.18
In the future, hybrid fairs (co-organizing physical and virtual fairs) will become widespread.	3.63	3.3	3.56
With the development of technology, physical fairs will lose their importance in the future.	2.89	2.48	2.80

First of all, when the averages of the answers given by the entire sample to the survey questions are evaluated, it can be seen that the issues of ease of access to virtual fairs and lack of physical contact stand out. Apart from this, the participants question sectoral suitability. It is widely believed that virtual fairs would be as crucial in the future as they are today.

Examining the cluster averages, it was determined that the attitudes of the first cluster are positive, while the second is not. The first cluster constitutes 77.4 % of the sample. So, it can be understood that the attitude towards virtual fairs is optimistic despite the negative aspects.

The items of which negative and positive attitudes groups differ the most are in the advantages dimension. Specifically,

- “Virtual fairs are suitable environments for the promotion of existing products.” The difference between the means of the answers given to the item is 1.94.
- “Virtual fairs offer opportunities, especially for small businesses that want to reach the global market.” The difference between the means of the answers given to the item is 1.75.

- “The existence of a wide variety of digital communication channels is an important advantage of virtual fairs.” The difference is 1.74.

The differences in the averages of the items in the dimensions of disadvantages are low. For example, the two clusters have almost the same average in the item, questioning the lack of physical contact. Therefore, the sample has an attitude close to consensus on the disadvantages of virtual fairs; however, it can be argued that there are divergences regarding the benefits provided.

4.4. Chi-Square Test Results

The distribution of the answers given regarding the level of agreement with the statement “Virtual fairs are not suitable for our industry.” on the basis of clusters is given in Table 6. As seen in Table 6, participants who think that the industry is suitable for virtual fairs usually adopt a positive attitude. Chi-square analysis results also show that the H₁ hypothesis is accepted.

Table 6. Distribution of Responses to Industry Suitability by Clusters

	The group with a positive attitude	The group with a negative attitude	Total
I strongly disagree	20	4	24
I disagree	64	9	73
I neither agree nor disagree	40	6	46
I agree	30	13	43
I strongly agree	4	14	18
Total	158	46	204

Pearson Chi-Square: 23.494, Asymp. Sig. (2- sided) < 0.001

Linear-by-linear association: 18.380, Likelihood Ratio: 21,937

Table 7 examines in which industries the participants are predominantly positive and in which ones they are negative. Although it is impossible to generalize the results on an industrial basis since the sample shows a very fragmented view of industries, the data in this table is valuable in providing insight.

Table 7. Positive and Negative Clusters According to Industries*

Industries	Positive Attitude		Negative Attitude	
	Frequency	%	Frequency	%
Ferrous and Non-Ferrous Metals	8	80	2	20
Food industry	40	75	13	25
Service	8	100	0	0
Machinery and Parts	18	69	8	31
Furniture and Forest Products	14	82	3	18
Agriculture and Livestock	6	60	4	40
Textile and Apparel	12	100	0	0
Building and Construction Materials	28	78	8	22

* Since the percentage analysis of the sectors with few total participants in the table above will not yield meaningful results, these sectors are not included.

Examining Table 7, it can be seen that all the participants from the service and textile sectors have adopted a positive attitude and that the group that has the most negative attitude operates in the

agriculture and livestock industry, followed by the machinery. Although the number of businesses in the sample is insufficient to generalize, it is not wrong to suggest that promoting services in the virtual fair can be done more effectively than the goods.

The results of the Chi-square test on the distribution of clusters with positive and negative attitudes by the age of the businesses and the test regarding the relationship between these two variables are presented in Table 8. As a result of the analysis, there is no relationship between the age of businesses and the attitude developed toward virtual fairs. H_2 is rejected.

Table 8. Positive and Negative Clusters According to the Age of the Businesses

Attitudes Toward Virtual Fairs	Age of Business		
	<10	10-19	≥20
The group having a positive attitude	88	23	47
The group having a negative attitude	23	9	14
Total	111	32	61

Pearson Chi-Square: 3.692, Asymp. Sig. (2- sided) = 0.159

Linear-by-linear association: 1.888, Likelihood Ratio: 3.422

Table 9 presents the distribution of clusters with positive and negative attitudes by the size of the business and the Chi-square test results for testing the relationship between these two variables. As a result of the analysis, the H_3 hypothesis was rejected.

Table 9. Positive and Negative Clusters According to Sizes of the Businesses

Attitudes Toward Virtual Fairs	Number of Employees		
	<50	50-100	>100
The group having a positive attitude	88	23	47
The group having a negative attitude	23	9	14
Total	111	32	61

Pearson Chi-Square: 0.788, Asymp. Sig. (2- sided) = 0.674

Linear-by-linear association: 0.185, Likelihood Ratio: 0.763

5. CONCLUSION AND RECOMMENDATIONS

The spread of virtual trade fairs, a product of digitalization within the scope of the new economy, is gradually increasing both as the obligations arising from the COVID-19 pandemic and the necessity of the current age. Results of the study show that attitudes toward the virtual fairs seem to be positive and the organizers plan to increase the number of these activities in the future (Choi et al., 2023). However, the theoretical and empirical research on virtual fairs is somewhat premature and does not seem focused. Therefore, this research contributes to the formation of this literature by proposing an antecedent of virtual trade fair loyalty, which is the participants' attitudes and the dimensions which form this construct. The results obtained in the study are discussed below in terms of theoretical perspective and managerial implications, and suggestions are made for future research.

Considering the results of the study on a theoretical basis, the following evaluations can be made. The easiness and usefulness of the technology are essential factors in TAM and DI models.

However, in the present study, only the advantages and disadvantages are seen to be the factors playing a role in the development of the attitudes. The items related to the technology's easiness are excluded from the analysis. Variables of TAM and their significance vary in each context (Gangwar et al., 2014), so these results are parallel to the literature.

The physical fairs are more challenging to participate in. Because the physical transfer of the employees, products, and booths is required. In addition, accommodation, transportation, and fair participation fees bring high financial costs. Virtual trade fairs are easier to participate in when compared to physical ones. The participants are likely to determine their attitudes by only focusing on the advantages and disadvantages, rather than the ease of use. Secondly, in TAM, the advantages are handled as long- and short-term advantages. Likewise, the findings in this research support this model.

The advantages emphasized regarding the wider market scope and reach are in parallel with the study carried out by Sarmiento and Simoes (2019). However, in their study, the cost was emphasized as an advantage. On the other hand, in the present research, the cost is considered as a disadvantage because of the overpricing. Governments may include virtual trade fairs in their incentive programs or regulate prices to eliminate this disadvantage. Among the disadvantages, "lack of physical contact" draws attention. This finding is also in parallel with the study carried out by Bathelt, H. and Schuldt, N. (2010), which underlines the disadvantageous position of virtual fairs regarding face-to-face interaction and observation.

The organizational factors that may impact technology acceptance seem to be irrelevant, except for the industry kind, in the case of virtual fairs. Previous studies which related the age and size of the business to the technology acceptance also have yet to reach a consensus about their relevance (Premkumar, 2003; Zimmerman (2018); Aydiner et al. (2019); King and Gribbins (2002); Daniel and Grimshaw, 2002). So, the theory extensions should be done very carefully.

The results achieved in the present study allow the following suggestions to be made in terms of managerial practice: For fair organizers, it is recommended to focus on improving the conditions regarding the disadvantages of virtual fairs. Virtual reality technologies such as Metaverse may be integrated into virtual fairs in the future. Most participants seem to prefer hybrid alternatives until technological improvements are made to virtual trade fairs and participants accept these technologies. Such technologies will improve virtual fair experiences and remove some disadvantages. These recommendations are also consistent with the findings of Gottlieb and Bianch (2017) which suggest that the future of virtual trade fairs depends on the development of virtual trade fair technologies. Likewise, businesses may focus on integrating the data obtained from virtual fairs into their customer database and use database marketing. Thus, the effectiveness of virtual fairs might be increased. Such developments will improve the position of virtual trade fairs in the future. In addition, companies participating in fairs are recommended to decide on participation in virtual fairs regardless of their size, and age. Also, it can

be thought that virtual fairs are not suitable for every sector, as reported in the study carried out by Duman and Ecevit (2021).

The scarcity of academic studies on virtual fairs was frequently mentioned above. The following suggestions can be made for future studies on virtual fairs: The fair, which constitutes the sample of this study, includes many sectors and the pandemic period. Conducting studies on different samples and in normal economic periods to assess the generalizability and reproducibility of the results might bring new approaches to virtual fairs. In addition, future research may focus on an industrial study, which can add insight into which sectors are easier to adapt to virtual trade fairs and which are more difficult. Similarly, a future study may focus on the product characteristics rather than the industry of the businesses. Thus, it may be possible to draw conclusions by further examining the impact of the industry on virtual trade fairs by making multiple classifications, such as businesses operating in industrial or consumer markets, those selling durable or nondurable products, or those selling capital goods, raw materials, or intermediate products. Moreover, businesses underline the indispensability of physical without sacrificing the advantages of virtual. For this reason, expectations for hybrid fairs are higher than pure virtual ones. In this context, it is recommended that similar studies should be carried out focusing on hybrid fairs.

For the study, ethics committee permission document dated March 3, 2022 and numbered 113328 was obtained from the Sakarya University Ethics Committee.

The study has been crafted in adherence to the principles of research and publication ethics.

The authors declare that there exists no financial conflict of interest involving any institution, organization, or individual(s) associated with the article. Furthermore, there are no conflicts of interest among the authors themselves.

The authors contributed equally to the entire process of the research.

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A Study on the Mediating Role of Work-Family Conflict in the Effect of Workload Perception on Professional Burnout of Employees in the Energy Sector *

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Abstract

Previous research could not yield consistent results concerning the relationship between workload perception and dimensions of professional burnout. The present work examines the mediating role of work-family conflict (WFC) in the relationship between workload perception and the dimensions of professional burnout (emotional exhaustion, depersonalization, and lack of personal accomplishment). The population of this study consists of employees employed in 21 electricity distribution companies operating in the energy sector in Turkey. 221 usable data were obtained through the survey method. The data were tested with the SmartPLS 4 analysis program. The analysis found a significant positive relationship between workload perception and emotional exhaustion, depersonalization, and WFC. However, no significant correlation between workload perception and lack of personal accomplishment could be identified. Moreover, the study results confirmed a significant positive relationship between WFC and the three dimensions of professional burnout. Considering the mediating relationships, it was revealed that WFC plays a complementary partial mediating role in the relationship between workload perception and emotional exhaustion and depersonalization. Likewise, the full mediating role of WFC in the relationship between workload perception and a lack of personal accomplishment was confirmed. This research contributes significantly to literature and practice by showing that lack of personal accomplishment develops when workload perception turns into WFC.

Keywords: *Workload Perception, Work-Family Conflict, Professional Burnout.*



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1. INTRODUCTION

Energy, which is used in every area of daily life and represents the basic input of production, emerges as a necessary element for increasing the welfare level of nations (Koç & Kaya, 2015). Therefore, the energy sector is among the most critical and competitive sectors. As energy demands continue to increase and sustainability concerns come to the forefront, energy companies are under significant pressure to ensure both operational efficiency and continuous innovation (Dash et al., 2023). Employees in the energy sector usually face stressful and challenging situations in the workplace, such as long working hours, time pressure, high work targets, excessive workload, overtime, excessive emotional demands, and low job flexibility. It is stressed that unless the necessary measures are taken in this respect, employees' stress levels will increase (Gümüştekin & Öztemiz, 2005), professional burnout and turnover intention will increase, and employee performance will decrease (Zincirkıran et al., 2015).

Professional burnout refers to a chronic state of exhaustion, which emerges due to long-term exposure to emotional and physical demands in individuals' jobs (Schwarzer & Hallum, 2008). Burnout is characterized by emotional exhaustion (depletion of emotional resources), depersonalization (cynical attitude and detachment from work), and lack of personal accomplishment (decreased sense of competence at work) (Bakker et al., 2004). While there are studies in the literature supporting that workload perception is an antecedent of professional burnout (e.g., Yaku et al., 2020; Deniz & Kaya, 2021; Çıngı & Şantaş, 2023; Bartram et al., 2023; Mücevher & Çetinceli, 2023), the available studies (e.g., Portoghese et al., 2014; Woranetipo & Chavanovanich, 2021; Azizoğlu et al., 2022) could not yield consistent results specifically on the sub-dimensions of professional burnout.

In line with the job demands-resources theory, job demands comprise factors (such as time pressure and workload) that decrease health and energy and cause significant mental disorders over time and, ultimately, low employee performance (Demerouti & Bakker, 2011). To meet higher job demands, employees initially tend to exert maximum physical and mental effort to effectively manage occupational stress, even at the expense of their health. Consequently, additional workload, time pressure, and work-life imbalance create a state of burnout that can considerably threaten the well-being of employees. In other words, professional burnout usually occurs because of high job demands (workload perception) and inadequate work resources (attention, energy, and time) that employees can use (Adil & Baig, 2018).

On the other hand, the high workload perception may threaten employees' energy and time, creating conflict since the time spent at work cannot be devoted to family and social activities (Lingard, Francis and Turner, 2010). According to the job demands-resources theory, employees who invest in resources (energy and time) in order to meet high job demands (workload perception) may have few or no resources left to manage their family activities and, therefore, may experience work-family conflict (WFC). Empirical research has also confirmed that workload perception impacts WFC (Macit & Arıncı,

2018; Göde, 2019; Şimşek & Koç, 2020; Korkmazer & Aksoy, 2020; Altıntop & Aydın, 2021; Türk, 2022; Sadiq, 2022; Galardo & Trottier, 2022). Nevertheless, this relationship has not been discussed in the context of the energy sector. Considering a great need for technicians, engineers, and other skilled workers due to the energy sector being capital- and technology-intensive (Dash et al., 2023), it makes sense to investigate the correlation between workload perception and WFC.

Additionally, in line with the job demands-resources theory, being unable to cope with WFC or manage the conflict can create stress and tension, leading to professional burnout (Bagherzadeh et al., 2016; Balogun, 2019). Evidence obtained from numerous studies demonstrates that WFC is an antecedent of professional burnout (e.g., Burke & Greenglass, 2001; Amstad et al., 2011; Haines et al., 2013; Lizano et al., 2014; Smith et al., 2018). However, the aforementioned relationship has not been examined on employees in the energy sector, and it has been minimally researched specifically on the sub-dimensions of professional burnout, and consistent results have not been obtained (Halbesleben, 2009; Balogun, 2014; Balogun, 2019; Jia and Li, 2022; Yarifard et al., 2023). It is essential to investigate these research gaps because providing necessary recommendations to decrease the impact of workload perception and WFC on the dimensions of professional burnout among employees in the energy sector can contribute to theory and practice.

Based on all the discussions, a research model was developed in the current study using the job demands-resources theory and tested with the SmartPLS 4 program. The model argues that the WFC of employees in the energy sector will mediate the positive relationship between workload perception and professional burnout dimensions.

2. THEORETICAL FRAMEWORK AND HYPOTHESIS DEVELOPMENT

2.1. Workload Perception and Professional Burnout

Professional burnout comprises three dimensions: emotional exhaustion, depersonalization, and lack of personal accomplishment. The first dimension, emotional exhaustion, includes physical or mental wear and tear, fatigue, and a feeling of loss of energy. The second dimension, depersonalization, means separating oneself from others, exhibiting cold emotions and reacting negatively to the attitudes of others, losing logic, and becoming irritable. Finally, lack of personal accomplishment can be expressed as an individual's perception of himself/herself as inadequate in professional terms, feeling unsuccessful in business life, and thinking that all his/her efforts to respond to incoming requests are inadequate (Portoghese et al., 2014; Azizoğlu et al., 2022). Especially Maslach, Schaufeli, and Leiter (2001) asserted that the three dimensions of professional burnout develop as a result of sequential progression over time. Specifically, researchers found that “emotional exhaustion occurs first, which leads to the development of depersonalization, which in turn causes a lack of personal accomplishment” (Alarcon, 2011; Portoghese et al., 2014). On the other hand, some researchers in the literature argue that

the lack of personal accomplishment is not among the dimensions of professional burnout (Tayfur and Arslan, 2012).

Workload perception involves many factors, such as physical and mental tasks, amount of work, time, and complexity. Workload perception in the job characteristics dimension is among the factors that affect burnout (Bolat, 2011). Several studies demonstrate that professional burnout is a consequence of high workload (e.g., Öztürk & Erdem, 2020; Phillips, 2020; Yaku et al., 2020; Deniz & Kaya, 2021; Çıngı & Şantaş, 2023; Bartram et al., 2023; Mücevher & Çetinceli, 2023).

Upon reviewing research on the sub-dimensions of professional burnout, emotional exhaustion, depersonalization, and lack of personal accomplishment are mentioned among the consequences of workload (Male & May, 1998; Karacaoğlu & Çetin, 2015; Xiaoming et al., 2014; Azizoğlu et al., 2022). Moreover, some researchers have identified a significant positive relationship between workload and emotional exhaustion (Greeenglass et al., 2001; Garrosa et al., 2010; Portoghese et al., 2014). On the contrary, some researchers have reported a significant positive correlation between workload and emotional exhaustion and depersonalization, but the absence of a significant relationship with a lack of personal accomplishment (Lee & Ashforth, 1996; Woranetipo & Chavanovanich, 2021; Tayfur & Arslan, 2012). As is seen, research on professional burnout sub-dimensions could not yield consistent results. Hence, filling the above-mentioned research gap can contribute to the literature.

According to the job demands-resources theory, professional burnout results from high job demands (workload, role conflict, and job pressure) or low job resources (time, energy, attention, social support, autonomy, and skill variety). This can be explained by the job demands-resources model, suggesting that workload can be perceived as a job demand, and if this job demand is exceeded, it may cause a higher level of burnout (Demerouti et al., 2014). The main purpose of this theory is to research job characteristics as antecedents of job strain and explain the significance of the balance between two categories of job characteristics (job demands and job resources). Especially the imbalance between these two categories of job characteristics causes employees to experience job stress and strain, including anxiety and burnout (Taris & Schaufeli, 2014).

Based on all these discussions, it can be assumed that workload perception is an antecedent of professional burnout sub-dimensions. Researchers in the literature mostly investigate the relationship between workload perception and professional burnout in service sector employees such as education, health, and tourism. There is no study on energy sector employees among the studies conducted, and the inconsistent results of the research on professional burnout sub-dimensions make the present study significant. Therefore, the following hypotheses were established in this study in accordance with the assumptions of the job demands-resources theory;

H1a: Workload perception has a positive impact on emotional exhaustion.

H1b: Workload perception has a positive impact on depersonalization.

H1c: Workload perception has a positive impact on the lack of personal accomplishment.

2.2. Workload Perception and WFC

As indicated by the job demands-resources theory, individuals aim to acquire and maintain personal characteristics (self-efficacy), circumstances (promotion), and individual resources (energy and time). Individuals may experience stress when these resources are threatened or lost (Hobfoll, 1989). Following the framework in question, it can be argued that workload is a job demand representing energy consumption in terms of time and psychological resources. For instance, the more time an individual spends at work, the more he/she may experience WFC since he/she does not have sufficient resources (time) to fulfill the roles expected of him/her at home. Resource consumption may occur because of a high workload, which can adversely impact individuals' role performance in the family and cause WFC (Edwards & Rothbard, 2000).

The literature review found no studies that reveal a generally positive relationship between workload perception and WFC (e.g., Göde, 2019; Şimşek & Koç, 2020; Korkmazer & Aksoy, 2020; Altıntop & Aydın, 2021; Türk, 2022; Sadiq, 2022; Galardo & Trottier, 2022). On the other hand, there is no study in the literature on employees in the energy sector. The following hypothesis was established in the present work according to the job demands-resources theory by considering that the workload perception of employees in the energy sector positively impacts WFC:

H2: Workload perception has a positive impact on WFC.

2.3. WFC and Professional Burnout

WFC represents an inter-role conflict that emerges when the resources allocated (energy and time), the tension experienced, and the behaviors expected from a role (work role) make it challenging to fulfill the obligations in another role (family role) (e.g., Carlson et al., 2000; Wang et al., 2012a). Netemeyer et al. (2005) indicated that role conflict creates pressure on emotional and cognitive resources, and individuals begin to believe that they cannot cope with all the expectations imposed on them in different roles. The aforesaid inter-role conflict originates from the inability to fulfill family responsibilities arising from work roles or work responsibilities arising from family (Wang et al., 2012a).

Previous researchers have demonstrated that the greater the WFC is, the greater the professional burnout an individual may experience (e.g., Alarcon, 2011; Mete et al., 2014; Laeeque, 2014; Wang et al., 2012b; Kremer, 2016; Macit & Ardiç, 2018). Whereas some of the few studies on the dimensions of professional burnout reveal the positive relationship between WFC and emotional exhaustion and depersonalization (Boles et al., 1997; Karatepe & Tekinkuş, 2006; Halbesleben, 2009; Jourdain & Chenevert, 2010; Ozor 2015; Tayfur & Arslan, 2012; Jia & Li, 2022), others have identified a significant negative relationship between WFC and lack of personal accomplishment (Fang, 2017; Yarifard et al., 2023). On the other hand, studies from Nigeria have identified a positive impact of WFC on burnout

and its dimensions (Balogun, 2014; Balogun, 2019). Consequently, it is seen that no definitive conclusion can be reached in the literature on the effect of WFC on professional burnout dimensions.

The current study uses the job demands-resources theory in order to explain the relationship between WFC and the dimensions of professional burnout (Bakker & Demerouti, 2007). According to the above-mentioned theory, individuals' coping skills and abilities decrease because of accumulated resource losses (time, energy) (WFC occurs), which can lead to more significant psychological distress in the form of burnout (Ratnaningsih & Idris, 2023). Accordingly, the following hypotheses were developed in accordance with the job demands-resources theory:

H3a: WFC has a positive impact on emotional exhaustion.

H3b: WFC has a positive impact on depersonalization.

H3c: WFC has a positive impact on lack of personal accomplishment.

2.4. The Mediating Role of WFC

Few empirical studies have indicated that WFC mediates the relationship between workload and burnout (Peeters et al., 2005; Karatepe et al., 2010; Mansour and Commeiras, 2015; Mansour and Tremblay, 2016). The study by Tayfur and Arslan (2012) revealed that WFC mediates the relationship between perceived workload and emotional exhaustion and depersonalization.

The job demands-resources theory can explain the mediating role of WFC in the relationship between perceived workload and professional burnout. According to the job demands-resources theory, employees with a high workload perception as a job demand consume valuable resources, such as time, energy, and emotions that are necessary for their family lives because they have to transfer their resources to their work lives (Lapierre and Allen, 2006). Individuals who face this loss of resources cannot fulfill their professional and family responsibilities simultaneously due to a lack of resources, and consequently, WFC may occur (Mansour and Commeiras, 2015; Mansour and Tremblay, 2016). To cope with WFC, individuals consume more resources, and thus, they cannot fulfill both their work-related duties and family responsibilities and may suffer from emotional exhaustion, depersonalization, and lack of personal accomplishment (Tayfur & Arslan, 2013; Mikolajczak & Roskam, 2018; Erdem, 2020). This study proposes the following hypotheses based on the assumptions of the job demands-resources theory:

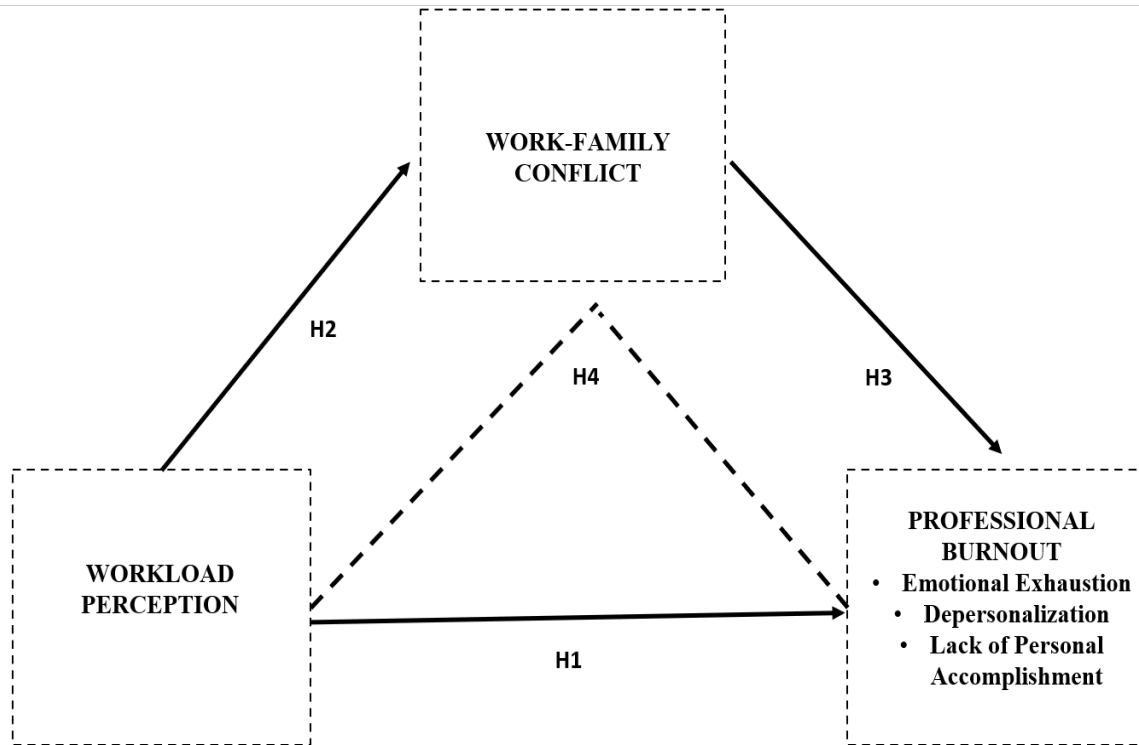
H4a: WFC mediates the significant positive relationship between workload perception and emotional exhaustion.

H4b: WFC mediates the significant positive relationship between workload perception and depersonalization.

H4c: WFC mediates the significant positive relationship between workload perception and lack of personal accomplishment.

Figure 1 displays the research model.

Figure 1. Research Model



3. RESEARCH

3.1. Population and Sample of the Study

Turkey has 21 electricity distribution regions and 21 electricity distribution companies (Ertlav & Aktel, 2015). This study’s population consists of employees employed in 21 electricity distribution companies operating in the energy sector in Turkey. Between August and October 2023, data was collected from employees of 21 electricity distribution companies using the survey method via Google Forms. 258 participants answered the survey and 221 usable data were obtained.

Concerning the participants’ demographic characteristics and professional experiences, 52.5% of the study participants are female, and 54.8% are in the 30-40 age range. Table 1 shows that 72.3% of the participants are married, 58.8% have a bachelor’s degree, and 32.1% have professional experience between 11 and 15 years.

The current research was performed with the Ethics Committee Approval Certificate of Istanbul Topkapı University Academic Research and Publication Ethics Board dated 10.07.2023 and numbered E-49846378-050.01.04-2300007954 and following the rules of scientific research and publication ethics.

Table 1. Demographic Data

	Demographic	Frequency	Percentage (%)
Gender	Female	117	52.9
	Male	104	47.1
Age	20-30	22	9.9
	30-40	121	54.8
	40-50	71	32.1
	50-60	7	3.2
Marital Status	Marital Status	159	72.3
	Unmarried	61	27.7
Education	High School	26	11.8
	Associate Degree	28	12.7
	Degree	128	58.2
	Master's Degree	35	15.9
	Doctorate	3	1.4
Experience	0-1 years	7	3.2
	2-5 years	33	14.9
	6-10 years	59	26.7
	11-15 years	71	32.1
	15+ years	51	23.1

3.2. Development of the Data Collection Tool

The survey form of the study, prepared in line with its purpose, consists of four sections. The first section includes questions about the participants' demographic characteristics, the second section includes questions to measure workload perception, the third section includes questions to measure burnout level, and the fourth section includes questions to measure WFC level.

The 11-item "Workload Perception" scale, developed by Peter Son et al. (1995) and adapted to Turkish by Derya (2008), was utilized to measure the workload perception level. The scale has a one-dimensional structure comprising 11 items.

The "Burnout" scale, developed by Maslach and Jackson (1981) and adapted to Turkish by Ergin (1993), was employed to measure the level of professional burnout. The Maslach Burnout Inventory has a 3-dimensional structure comprising 22 items that determine the level of emotional exhaustion, depersonalization, and personal accomplishment level. The personal accomplishment scale was reverse-coded and defined as a lack of personal accomplishment.

To measure WFC, the 5-item WFC scale, developed by Netemeyer, Boles, and McMurrian (1996) and adapted into Turkish by Korkmaz and Erdoğan (2014), was used. All scales are 5-point Likert scales (1=Strongly Disagree and 5=Strongly Agree).

3.3. Data Analysis and Findings

The data were entered into the SPSS program for statistical analysis. Partial least squares-structural equation modeling (PLS-SEM) was used to verify the hypotheses in the study. The data were

tested with the SmartPLS 4 analysis program, whose assumption is based on PLS-SEM. SmartPLS 4 software can be utilized to analyze non-normally distributed data and in studies with small samples. In SmartPLS software, data are analyzed in two steps using structural equation modeling techniques along with the measurement model.

3.3.1. Evaluation of the Measurement Model

When analyzing in the SmartPLS 4 analysis program, the measurement model is analyzed first. When evaluating the measurement model, factor loadings should be checked first. In the analysis of the measurement model, the LPA1 item, which belongs to lack of personal accomplishment, WP7 and WP8 indicators, which belong to workload perception, and the DPS4 item, which belongs to depersonalization, were excluded from the analysis since they were below 0.700, and the analysis was repeated. As seen in Table 2, the values of the items belonging to the constructs are above 0.700. Cronbach's alpha, composite reliability (CR), and rho_a values were examined to evaluate the internal consistency reliability of the survey. It can be stated that the data are statistically reliable if all of Cronbach's alpha, CR, and rho_a values are higher than 0.700 (Hair et al., 2019). Table 2 displays that Cronbach's alpha, CR, and rho_a values are higher than 0.700 for all latent variables. This study complies with internal consistency reliability criteria.

The average variance extracted (AVE) is employed to measure convergent validity. Calculating AVE for each component allows for evaluating the convergent validity of factor loadings, which is an essential tool for evaluating the reliability of factors. Table 2 contains the results for convergent validity. The results in the table demonstrate that all AVE values are higher than 0.500 and convergent validity is met.

Table 2. Measurement Model Results

Constructs	Items	Factor Loadings	P-Values	Cronbach's Alpha	rho A	Composite Reliability	AVE
Emotional Exhaustion (EM)	EM1	0.786	0.000	0.929	0.938	0.941	0.641
	EM2	0.865	0.000				
	EM3	0.875	0.000				
	EM4	0.758	0.000				
	EM5	0.847	0.000				
	EM6	0.804	0.000				
	EM7	0.737	0.000				
	EM8	0.809	0.000				
	EM9	0.706	0.000				
Lack of Personal Accomplishment (LPA)	LPA2	0.793	0.000	0.899	0.944	0.917	0.613
	LPA3	0.720	0.000				
	LPA4	0.743	0.000				
	LPA5	0.819	0.000				
	LPA6	0.763	0.000				
	LPA7	0.850	0.000				
	LPA8	0.785	0.000				
	Work-Family Conflict (WFC)	WFC1	0.894				
WFC2		0.936	0.000				
WFC3		0.926	0.000				
WFC4		0.917	0.000				
WFC5		0.853	0.000				

Table 2. (Cont.)

Constructs	Items	Factor Loadings	P-Values	Cronbach's Alpha	rho A	Composite Reliability	AVE					
Workload Perception (WP)	WP1	0.725	0.000	0.926	0.931	0.939	0.631					
	WP2	0.766	0.000									
	WP3	0.743	0.000									
	WP4	0.833	0.000									
	WP5	0.756	0.000									
	WP6	0.889	0.000									
	WP9	0.855	0.000									
	WP10	0.826	0.000									
	WP11	0.736	0.000									
	Depersonalization (DP)	DPS1	0.728					0.000	0.853	0.875	0.901	0.696
		DPS2	0.895					0.000				
DPS3		0.911	0.000									
DPS4		0.895	0.000									
DPS5		0.791	0.000									

The present study considered discriminant validity along with internal reliability and convergent validity. Discriminant validity investigates the level of correlation between the modeled constructs and shows how different the modeled constructs are from other constructs (Hair et al., 2010). Discriminant validity was examined with three methods in this study. First, the Fornell-Larcker criterion was evaluated. In the aforesaid method, the square root of the AVE value should be greater than the correlations between the constructs. The square roots of the AVE values (values shown in bold) of each of the constructs in Table 3 are higher than the correlation values in the current rows and columns. Hence, all constructs provide discriminant validity according to the Fornell-Larcker criterion.

Table 3. Fornell-Larcker Criterion

Constructs	1	2	3	4	5
DP	0.835				
EM	0.708	0.800			
LPA	0.437	0.519	0.783		
WP	0.494	0.592	0.278	0.794	
WFC	0.518	0.718	0.366	0.659	0.906

The heterotrait-monotrait ratio (HTMT) is the second method used in the study. The discriminant validity of the measurement model was checked using this method. An HTMT value less than 0.85 is appropriate for the accuracy of discriminant validity between constructs. No construct has a value higher than 0.85, as shown in Table 4. Therefore, it can be stated that the discriminant validity of the measurement model was confirmed according to the HTMT criterion.

Table 4. HTMT

Constructs	1	2	3	4	5
DP					
EM	0.791				
LPA	0.444	0.509			
WP	0.548	0.621	0.271		
WFC	0.571	0.756	0.347	0.700	

A third method, cross-loading values, should also be analyzed to examine the study's discriminant validity. The high indicator loadings (bold values) in each construct in Table 5 demonstrate that the cross-loading values required for the discriminant validity of these constructs are appropriate (Fornell and Larcker, 1981). Hence, the results meet all three methods required for discriminant validity in each construct.

Table 5. Cross-Loadings

Items	Depersonalization	Emotional Exhaustion	Lack of Personal Accomplishment	Workload Perception	Work-Family Conflict
EM1	0.504	0.786	0.391	0.381	0.563
EM2	0.556	0.865	0.432	0.540	0.652
EM3	0.575	0.875	0.420	0.514	0.640
EM4	0.577	0.758	0.367	0.457	0.561
EM5	0.651	0.847	0.403	0.553	0.631
EM6	0.584	0.804	0.481	0.601	0.634
EM7	0.621	0.737	0.379	0.338	0.434
EM8	0.563	0.809	0.469	0.464	0.528
EM9	0.477	0.706	0.399	0.313	0.460
DPS1	0.728	0.465	0.254	0.323	0.324
DPS2	0.895	0.651	0.414	0.490	0.479
DPS3	0.911	0.666	0.382	0.436	0.475
DPS5	0.791	0.556	0.386	0.378	0.430
LPA2	0.320	0.387	0.793	0.231	0.267
LPA3	0.242	0.242	0.720	0.153	0.131
LPA4	0.533	0.611	0.743	0.317	0.438
LPA5	0.256	0.318	0.819	0.171	0.230
LPA6	0.272	0.291	0.763	0.108	0.158
LPA7	0.330	0.422	0.850	0.245	0.324
LPA8	0.221	0.300	0.785	0.138	0.219
WFC1	0.462	0.608	0.277	0.622	0.894
WFC2	0.452	0.648	0.327	0.624	0.936
WFC3	0.458	0.680	0.364	0.581	0.926
WFC4	0.498	0.678	0.335	0.601	0.917
WFC5	0.474	0.634	0.352	0.557	0.853
WP1	0.399	0.446	0.241	0.725	0.404
WP2	0.364	0.485	0.149	0.766	0.579
WP3	0.405	0.463	0.241	0.743	0.483
WP4	0.438	0.523	0.259	0.833	0.520
WP5	0.326	0.368	0.218	0.756	0.491
WP6	0.470	0.534	0.229	0.889	0.595
WP9	0.402	0.508	0.256	0.855	0.658
WP10	0.311	0.416	0.235	0.826	0.509
WP11	0.397	0.462	0.156	0.736	0.429

Finally, analysis was performed using the 5000 resampling method to reveal whether the indicators of each construct in the measurement model were statistically significant. The analysis shows that each indicator is loaded statistically significantly on the construct it belongs to.

3.3.2. Evaluation of the Structural Model

According to the structural evaluation criteria, the problem of multicollinearity, path coefficient, R^2 value explaining the percentage rate of the endogenous variable, and Standardized Root Mean Square (SRMR) and Normed Fix Index (NFI) values are examined.

Whether there is a multicollinearity problem is assessed according to the Variance Inflation Factor (VIF) value. The VIF values of all variables in the current study (see Table 6) are below 3. The above-mentioned result indicates that there is no multicollinearity problem. After multicollinearity control is ensured, the significance between the latent variables of the model is assessed, and the path coefficient is employed to determine whether there is a correlation between the dependent, independent, and mediator variables. P and t-values should be obtained to examine direct and indirect impacts using the bootstrap method. Analysis was conducted by creating 5000 resamples. According to the study's first finding, the correlation between workload perception and emotional exhaustion ($\beta = 0.208$; $t = 2.597$; $p = 0.009$) is positively significant. Likewise, the relationship between workload perception and depersonalization ($\beta = 0.270$; $t = 2.722$; $p = 0.007$) is positively significant. Hence, hypotheses H1a and H1b were accepted. Nevertheless, when the relationship between workload perception and lack of personal accomplishment is examined, it is seen that the relationship in question ($\beta = 0.064$; $t = 0.619$; $p = 0.536$) is insignificant (see Table 6). Accordingly, hypothesis H1c was rejected.

According to another result of the research, the relationship between workload perception and WFC is positively significant ($\beta = 0.659$; $t = 14.349$; $p = 0.000$). Therefore, hypothesis H2 was supported. Similarly, all of the relationships of WFC with emotional exhaustion ($\beta = 0.581$; $t = 8.470$; $p = 0.000$), depersonalization ($\beta = 0.340$; $t = 3.606$; $p = 0.000$), and lack of personal accomplishment ($\beta = 0.325$; $t = 3.556$; $p = 0.000$) were positively significant, and hypotheses H3a, H3b, and H3c were accepted.

The R^2 value, measured as the percentage of the total variance that can be attributed to the internal constructs of the model, determines the model's ability to explain data. Upon examining the R^2 values in Figure 2, it was found to be 0.434 for WFC, 0.539 for emotional exhaustion, 0.309 for depersonalization, and 0.137 for lack of personal accomplishment, and these values can be considered good.

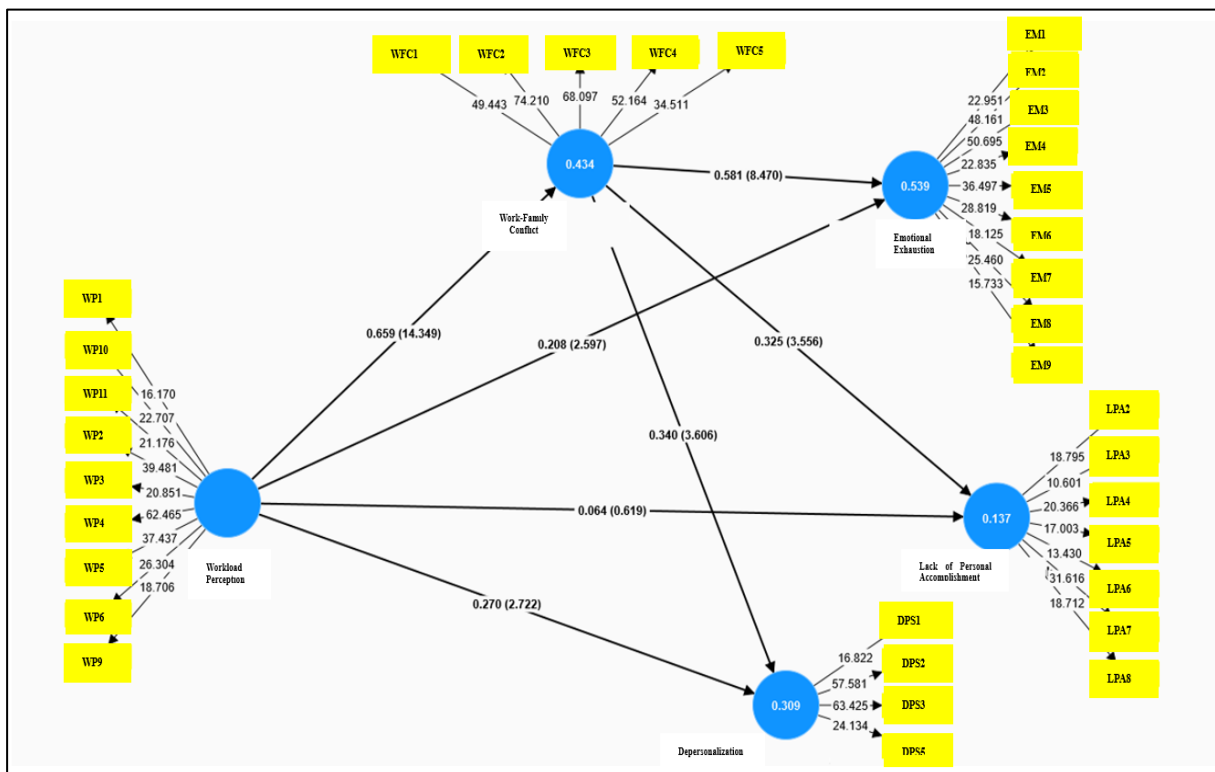
SRMR is defined as the mean of the standardized residuals between the observed and predicted covariance (Pavlov et al., 2021). An SRMR value of 0.08 or lower is accepted as optimal. The SRMR value calculated in the model is 0.052. It is desired that the NFI value should be greater than 0.80. Since the NFI value of the current model is 0.83, these values indicate that the model is compatible.

Table 6. Hypothesis Testing

Path Coefficients	Coef (β)	S.D.	T-Values	P-Values	Adj. R ²	f ²	VIF	Confidence Interval Bias Corrected		Conclusion
								Lower Level	Upper Level	
WFC→ DPS	0.340	0.094	3.606	0.000	0.309	0.095	1.768	0.159	0.527	H3b Supported
WP→ DPS	0.270	0.099	2.722	0.007						
WFC→ LPA	0.325	0.091	3.556	0.000	0.136	0.068	1.768	0.437	0.710	H3c Supported
WP→ LPA	0.064	0.103	0.619	0.536						
WP→ WFC	0.659	0.046	14.349	0.000	0.434	0.768	1.000	0.557	0.740	H2 Supported
WFC→ EM	0.581	0.069	8.470	0.000	0.540	0.414	1.768	0.115	0.482	H3a Supported
WP→ EM	0.208	0.080	2.597	0.009						

By examining the effect size (f²) value, it can be found whether an independent construct significantly impacts the dependent construct. The f² values of the present study vary between 0.054 and 0.768, and it can be stated that the independent construct has moderate to large effects on the dependent constructs (Gefen et al., 2011). According to the results, workload perception significantly impacts WFC, whereas WFC significantly impacts emotional exhaustion.

Figure 2. Results of the Structural Model



The mediation procedure employed by Zhao, Lynch, and Chen (2010) was followed in order to test the mediating effect of WFC in the relationship between workload perception and professional burnout (depersonalization, emotional exhaustion, and lack of personal accomplishment). Table 7

contains the test results for the mediating effect of WFC. The findings demonstrate that WFC is the mediator variable in the relationship between workload perception and emotional exhaustion ($\beta = 0.383$; $t = 7.028$; $p = 0.000$). To determine the level of mediating effect, the correlation between workload perception and emotional exhaustion was assessed, and since the above-mentioned effect was also significant ($\beta = 0.208$; $t = 2.597$; $p = 0.009$), it was concluded that WFC has a complementary partial mediating role. Therefore, hypothesis H4a was supported.

According to the results, the mediating role of WFC in the relationship between workload perception and depersonalization was confirmed ($\beta = 0.224$; $t = 3.416$; $p = 0.001$). When the relationship between workload perception and depersonalization was evaluated to determine the level of the mediating role ($\beta = 0.270$; $t = 2.722$; $p = 0.007$), the relationship in question was significant, and it can be said that WFC has a complementary partial mediating role. In line with this, hypothesis H4b was supported.

Furthermore, the results supported the mediating role of WFC in the relationship between workload perception and lack of personal accomplishment ($\beta = 0.214$; $t = 3.411$; $p = 0.001$). It is seen that the direct relationship between workload perception and lack of personal accomplishment is insignificant ($\beta = 0.064$; $t = 0.619$; $p = 0.536$). Accordingly, WFC fully mediates the relationship between workload perception and lack of personal accomplishment. Hence, hypothesis H4c was confirmed.

Table 7. Mediation Analysis

Path Coefficients	Coef (β)	S.D.	T-Values	P-Values	Confidence Interval		Conclusion
					Bias Corrected Lower Level	Upper Level	
WP→ WFC→ EM	0.383	0.054	7.028	0.000	0.284	0.496	H4a Supported Complementary Partial Mediation
WP→ EM	0.208	0.080	2.597	0.009	0.043	0.359	
WP→ WFC→ DPS	0.224	0.066	3.416	0.001	0.107	0.362	H4b Supported Complementary Partial Mediation
WP→ DPS	0.270	0.099	2.722	0.007	0.062	0.455	
WP→ WFC→ LPA	0.214	0.063	3.411	0.001	0.079	0.329	H4c Supported Full Mediation
WP→ LPA	0.064	0.103	0.619	0.536	-0.152	0.257	

4. CONCLUSIONS

4.1. Discussion

The present study investigated the mediating role of WFC in the relationship between workload perception and the emotional exhaustion, depersonalization, and lack of personal accomplishment sub-dimensions of professional burnout in a sample of employees of 21 electricity distribution companies operating in the energy sector in Turkey. In this regard, the four research questions, (1) Does workload perception impact the sub-dimensions of professional burnout?, (2) Does workload perception impact WFC?, (3) Does WFC impact the sub-dimensions of professional burnout? and (4) Does WFC mediate the relationship between workload perception and the sub-dimensions of professional burnout?, were analyzed with the data collected from 221 employees of 21 electricity distribution companies operating in the energy sector.

In line with the first hypothesis, it was found that workload perception significantly positively impacts the emotional exhaustion and depersonalization dimensions of professional burnout. Accordingly, hypotheses H1a and H1b were accepted. The result mentioned above supports the researchers argument that workload perception, which is indicated among the work-related stressors, positively impacts emotional exhaustion and depersonalization, the dimensions of professional burnout (Male & May, 1998; Xiaoming et al., 2014; Karacaoğlu & Çetin, 2015). Contrary to this result, it was observed that workload perception is not significantly correlated with lack of personal accomplishment, the sub-dimension of professional burnout, and hypothesis H1c was rejected. The aforesaid result supports the researchers who assert that workload perception does not significantly impact the lack of personal accomplishment, which is attributed to an individual feeling unsuccessful and thinking that all efforts are inadequate to respond to demands (Lee & Ashforth, 1996; Tayfur & Arslan, 2012; Woranetipo & Chavanovanich, 2021). This result confirms the assumptions of scientists who assert that professional burnout develops due to sequential progression changing over time (Maslach et al., 2001). In this respect, it can be stated that workload perception in employees of the energy sector first creates emotional exhaustion, and then depersonalization develops. Workload perception did not directly lead to a lack of personal accomplishment in energy sector employees.

Another result of the study demonstrated that the impact of workload perception on WFC was significant. Hence, hypothesis H2 was accepted. The above-mentioned result supports studies in the literature and strengthens the existence of this relationship (Mansour & Tremblay, 2016; Korkmazer & Aksoy, 2018; Macit & Arđınç, 2018; Göde, 2019; Şimşek & Koç, 2020; Korkmazer & Aksoy, 2020; Altıntop & Aydınıtan, 2021; Türk, 2022; Sadiq, 2022; Galardo & Trottier, 2022). Likewise, in line with another result of the study, the relationships between WFC and emotional exhaustion, depersonalization, and lack of personal accomplishment are significant. Accordingly, hypotheses H3a, H3b, and H3c were accepted. In the literature, studies investigating the impact of WFC on the dimensions of professional burnout are both limited and have not yielded consistent findings. This result supports the researchers

defending the idea that WFC is an antecedent of emotional exhaustion (Halbesleben, 2009; Karatepe & Tekinkuş, 2006; Jourdain & Chenevert, 2010; Tayfur & Arslan, 2012; Balogun, 2014; Ozor, 2015; Balogun, 2019; Jia & Li, 2022; Yarifard et al., 2023), depersonalization (Tayfur & Arslan, 2012; Balogun, 2014; Ozor, 2015; Balogun, 2019; Jia and Li, 2022; Yarifard et al., 2023), and lack of personal accomplishment (Balogun, 2014; Balogun, 2019).

The findings of the research on the mediating role of WFC demonstrate that WFC has a complementary partial mediating role in the relationship between workload perception and emotional exhaustion and depersonalization. Therefore, hypotheses H4a and H4b were accepted. The aforesaid result supports the study by Tayfur and Arslan (2012), asserting that WFC mediates the relationship between workload perception and emotional exhaustion and depersonalization. Finally, according to the study results, WFC was found to be a full mediator in the relationship between workload perception and lack of personal accomplishment. Hence, hypothesis H4c was supported. This result contributes significantly to the literature and practice by showing that the lack of personal accomplishment develops when workload perception turns into WFC. The current work supports the few studies in the literature indicating that WFC mediates the correlation between workload and professional burnout (Janssen et al., 2004; Peeters et al., 2005; Karatepe et al., 2010; Mansour & Tremblay, 2016) and strengthens this correlation.

4.2. Theoretical Contributions

The current study has several theoretical contributions. It contributes to the literature by revealing that employees in the energy sector are exposed to a high workload. The first finding of the present study shows that workload perception impacts emotional exhaustion and depersonalization, but not the lack of personal accomplishment and supports the researchers who assert that the three dimensions of professional burnout develop as a result of sequential progression changing over time (Maslach et al., 2001; Alarcon, 2011; Portoghese et al., 2014), thus, strengthening this assumption.

The second finding of the study strengthens the job demands-resources theory by providing an appropriate framework for understanding how employees' time and energy (i.e., resources) are depleted due to their workload perception (job demands), leading to WFC.

The third finding of this study further strengthens the position of the job demands-resources theory by indicating that WFC is an essential factor that threatens employees' energy and resources and that long-term exposure to such stressors will, over time, cause emotional exhaustion, depersonalization, and a lack of personal accomplishment.

The fourth finding of the study strengthens the assumptions of the job demands-resources theory by demonstrating that WFC has a complementary partial mediating role in the relationship between workload perception and emotional exhaustion and depersonalization.

Based on the job demands-resources theory, the last finding of the research contributes significantly to the literature by confirming that WFC fully mediates the impact of workload perception on the lack of personal accomplishment in an industry (energy) characterized by significant work-family balance problems.

4.3. Practical Contributions

Along with theoretical contributions, the present work also makes practical contributions to organizations and individuals. First, the current study underlines the importance of employers implementing actions to decrease employee workload in the energy sector. Hence, it is essential for organizations in the energy sector to address workload perceptions. The study results indicate the positive impacts of workload perception on emotional exhaustion and depersonalization. Therefore, it can be recommended that managers establish appropriate working hours, coordinate regular working hours and days off, and reduce workload by increasing work and rest periods.

The second finding shows that workload perception is an antecedent of WFC. Particularly working conditions such as long and irregular working hours (including evenings and weekends), lack of paid leave to deal with family matters, lack of a flexible work schedule, pressure to complete a job, and unpredictability of the end time of workdays are indicated as reasons for high WFC (Lingard & Sublet 2002, Lingard et al., 2010). In this respect, alleviating the workload will decrease the negative impacts on the work-family interface, thus reducing WFC. Since workload perception is defined as a major reason behind WFC as excessive job demands drain the energy and time of employees, it can be recommended that management plans this appropriately through voluntary part-time working hours, compressed work weeks, working from home, flexible time, and family leaves. Such strategies can decrease WFC by helping employees fulfill their family roles. Moreover, management can organize employee training programs to maintain boundaries between work and family roles.

The third finding indicates that WFC impacts emotional exhaustion, depersonalization, and lack of personal accomplishment. Especially managers and supervisors can encourage employees to spend their free time on non-work-related activities.

The fourth finding demonstrates the complementary partial mediating role of WFC in the relationship between workload perception and emotional exhaustion and depersonalization and the full mediating role of WFC in the relationship between workload perception and lack of personal accomplishment. Hence, managers can reduce bureaucratic procedures that increase workload perception, organize training programs so that employees can use their time correctly and effectively, and offer facilities such as nurseries and kindergartens to establish work-life balance. Thus, professional burnout can be decreased by preventing WFC caused by workload perception.

4.4. Limitations and Recommendations

This study attempted to reveal the mediating role of WFC in the relationship between workload perception and professional burnout of employees of 21 electricity distribution companies operating in the energy sector with a limited sample group. The present research findings were obtained based on the subjective opinions of the energy sector employees who contributed to the study. In this case, the objectivity of the study can be questioned. Future studies can be performed with a more comprehensive sample. Furthermore, this study stresses the mediating role of WFC in the relationship between workload perception and professional burnout. Future studies can examine other concepts that may mediate between the two concepts.

For the study, ethics committee permission document dated July 10, 2023 and numbered E-49846378-050.01.04-2300007954 was obtained from the İstanbul Topkapı University Ethics Committee.

The study has been crafted in adherence to the principles of research and publication ethics.

The authors declare that there exists no financial conflict of interest involving any institution, organization, or individual(s) associated with the article.

The corresponding author of the study contributed to the planning of the research; the second author of the study contributed to data collection and analysis, the literature review and discussion and results sections.

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The Individual, Organizational and Social Contexts of Teleworking and Technostress during Covid-19 Pandemic: A Holistic Analysis based on JD-R Model

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Abstract

The purpose of this study is to reveal the researches that deal with teleworking and technostress together with their individual, organizational and social dimensions in a holistic way within the framework of the Job Demands-Resources (JD-R) Model. In this study, a review was carried out on the Web of Science (WoS) and the Scopus databases with the assistance of bibliometric analysis techniques and the PRISMA method. The thematic content analysis method was used to reveal on which dimensions of technostress associated with teleworking and on which methods the focuses were. It can be stated that the results of the relationship analysis based on keyword frequency, performance analysis and thematic content analysis carried out within the scope of the research are consistent with each other. At this point, the findings of the research have revealed that technostress poses a dark side to teleworking as an organizational behavior challenge stemming from the COVID-19 pandemic. The current study found that teleworking-related technostress significantly affects employee well-being, with important impacts on the ISO 45003:2021 standard, and the Sustainable Development Goal 3. On the basis of being such a comprehensive and comparative research on the subject, it contributes to the relevant literature and practice.

Keywords: *Teleworking, Technostress, JD-R Model, Employee Well-Being, SDG 3.*

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1. INTRODUCTION

Teleworking was proposed in the 1970s as an alternative way of organizing work independent of space and time using information and communication technologies. In this respect, it has been seen as a win-win strategy that is a solution to individual, organizational and social problems. It is noted that teleworking, which is described as an application that provides flexibility for employees because it eliminates workplace dependence and reduces transportation problems, has positive effects on job satisfaction, motivation, and work-family balance. In terms of business management, advantages such as saving space, reducing employment costs, reducing general expenses, minimizing personnel problems such as absenteeism, and increasing efficiency and profitability are emphasized. On the basis of its location-independent nature of work, the potential to reduce traffic, air pollution, and dependence on fossil fuels; to create a new employment area for women and disabled people who have difficulties in accessing the normal labor market; with the claims that it can be applied as a business continuity tool in extraordinary situations that create strict restrictions such as the COVID-19 pandemic, its potential to contribute to environmental, social and economic sustainability are highlighted (Gálvez et al., 2020; Madsen, 2003; Moglia et al., 2021).

The 2030 Sustainable Development Agenda (SDA), adopted by all United Nations (UN) Member States in 2015; consists of 17 Sustainable Development Goals (SDGs) based on origins such as combating poverty, hunger, inequality, and climate change, improving health and education, ensuring gender equality, promoting decent work and economic growth (<https://sdgs.un.org/goals>). From a working life perspective, it is seen that at least 6 (SDG 5: gender equality, SDG 8: decent work and economic growth, SDG 9: industry, innovation, and infrastructure, SDG 10: reduced inequalities, SDG 11: sustainable cities and communities, and SDG 12: responsible consumption and production) of the 17 targets are focused on improving employee well-being and business organizations. In this context, teleworking, which has become widespread with the COVID-19 pandemic, is also considered as an opportunity-creating practice, starting from the focus of organization and management, to help achieve sustainable development goals (Gálvez et al., 2020). Because flexible and remote working models such as teleworking can encourage the creation and maintenance of healthy, safe, and decent working conditions. Thus, they can provide employees with the experience of meaning at work (Elrayah, 2021).

On the other hand, the presence of findings pointing to the paradoxical nature of teleworking in the context of the dark side of organizational behavior is also remarkable. In this context, weakening of organizational communication and integration due to social isolation (Allen et al., 2015; Morganson et al., 2010); burnout (Kasemy et al., 2022; Singh et al., 2022); well-being problems (Arslan et al., 2022; Molino et al., 2020); health complaints (Elizalde, 2021; Wöhrmann and Ebner, 2021); work-family conflict (Golden et al., 2006; Lapierre & Allen, 2006); and technostress (Camacho & Barrios, 2022; Jaiswal et al., 2022) are often seen as the main challenges of teleworking. Therefore, while being able to work from anywhere with the information systems infrastructure, sharing with colleagues in real-

time, and accessing information quickly and easily is one aspect of this dichotomy, on the other side of this dichotomy, it should not be ignored that there are issues pointing to technostress such as the fact that being in constant contact blurs the home and work contexts, being trapped in multitasking, having to respond to work-related demands in real-time, being distracted by the constant flow of information, and lack of time for thinking and creative analysis (Tarafdar et al., 2011). It is important not to ignore practices such as change management, leadership support, a supportive organizational culture, user experience design, and end-user training to reduce the negative effects of the dark side of digital workplace technologies, such as overload, distraction, addiction, stress, anxiety, phobia, exhaustion, and burnout (Marsh et al., 2022). At this point, creating a social culture that prioritizes emotional social support, fosters mutual aid, and supports employees' emotional well-being should not be overlooked, even as organizational support strategies that prioritize a culture of continuous learning and strengthening employees technically are being developed (Khedhaouria et al., 2024).

At this point, rather than focusing on whether teleworking is an advantageous job design method with an approach that prioritizes only organizational and managerial interests, it is thought that it is necessary to focus on how to design, organize and implement teleworking based on a win-win strategy for all parties of the employment relationship, with an approach that also considers employee interests. In addition, such an approach is expected to reveal critical implications for the effectiveness of hybrid working arrangements, which are predicted to be the dominant model for the future of work with the impact of both the digital transformation in the age of Industry 4.0 and the COVID-19 pandemic and are based on the discourses of employers that it is built on the basis of combining the advantageous aspects of teleworking and office work, and that it is considered important in terms of sustainable development. With this perspective, this study aims to examine the researches that deal with teleworking and technostress together with their individual, organizational and social dimensions in a holistic way and to discuss them in the context of organizational behavior.

2. THEORETICAL FRAMEWORK

2.1. Teleworking

Teleworking is a broad and complex phenomenon with no single, widely accepted definition. Works made from places other than a traditional office space are called telework, telecommuting, virtual work, home-based teleworking, mobile telework, remote work, etc. (Nakrošienė et al., 2019). In this context, teleworking is defined as performing work outside the employer's premises by using information and communication technologies such as desktop computers, laptops, tablets and smartphones (Eurofound and the International Labor Office, 2017). In other words, teleworking is the ability of employees to access their business activities from outside the office through information and communication technologies (Nilles, 1997). Teleworking is not a new type of work in comparative law. In this context, it is emphasized that in the transition to teleworking and working in the workplace, an agreement should be reached between the employee and the employer on the basis of "volunteerism".

With this principle, the employee's individual approval is required for teleworking. However, in the extraordinary conditions that emerged with the COVID-19 pandemic, it has inevitably turned into a necessity for the workers who fulfill their work debt in the ordinary period to the remote working model (Baycık et al., 2021). In such a challenging period, information and communication technologies have played a central role in facilitating the transition to teleworking and its rapid spread. The practicality provided by information and communication technologies in conducting teleworking operations has provided strong links by many employers that this working model will be the new normal and has forced them to produce active policies for a more sustainable teleworking model (Jaiswal et al., 2022).

Facts such as knowledge management, which attracts great attention by organizational management in order to ensure sustainable competition today, innovative and result-oriented approaches based on high flexibility, lean and agile structures, and work-life balance also lead to the development of effective strategies for teleworking-style applications by reconsidering the traditional work context. At this point, it is underlined that the common emphasis of many definitions of teleworking based on different perspectives such as psychological, sociological, and political literature is “allowing employees to work wherever and whenever they want as long as it gives correct results” (Pigini & Staffolani, 2019). In addition to being evaluated as a working system that provides flexibility at the individual, organizational and social level since it is not limited by time and space, in terms of blurring of work and private life contexts, it is important for employees to fit teleworking norms and create a perception of harmony for the healthy growth of the remote working ecosystem based on strong foundations (Jaiswal et al., 2022).

In addition, the fact that the obligation to work in a teleworking relationship is mostly performed through information and communication technologies necessitates that some issues in terms of social security law should not be ignored. In this context, it is important to determine how the provisions on occupational accidents and diseases will be applied in a teleworking relationship. Because teleworking carries the risk of creating danger in terms of eye and body health and orthopedic disorders in employees based on the intensive use of technological communication tools. In addition, the increase in the frequency of mental work of employees, the pressure to always be reachable, the feeling of inadequacy that arises in keeping up with the constantly developing and changing technology, and the blurring of the boundary between home and work life can also bring about some mental and behavioral problems. In this context, determining the appropriate causal link in accepting occupational diseases in teleworking relationships and updating the list of occupational diseases on this basis constitutes a priority agenda (Çelebi Demir, 2023).

2.2. Technostress

It has been noted that the sudden intensification of the work model based on digital technologies during the COVID-19 pandemic, which brings great challenges for the workforce globally, creates more

technostress for employees than ever before (Chakraborty & Kar, 2021). In this sense, technostress is described as a “modern adaptation disease” and is considered as the stress caused by the inability to adapt and cope with information technologies in a healthy way (Wang et al., 2022). On the other hand, Tarafdar et al. (2007) based technostress on the basis of sociotechnical theory and role theory. Accordingly, organizations have two important dimensions as sociotechnical systems. The social dimension includes employees' abilities, attitudes, values, roles, reward systems and authority structures. The technical dimension, on the other hand, is task-oriented and includes jobs or job-related processes and technologies. Roles within the organization are determined in parallel with these two dimensions. In this direction, on the one hand, there are roles such as subordinate-superior relations depending on the social system of the employees. On the other side, there are task-oriented roles that are consistent with technical systems that regulate balances such as hierarchy, authority, coordination, and control. The changes that occur in these two basic systems give a dynamic quality to the organizational roles of the employees. Change in the social system is largely due to human relations. Change in the technical system often transforms individual roles more abruptly and more rapidly than the social dimension.

Advances in information and communication technologies inevitably transform organizational structures and processes, ways of doing jobs, and change individual roles. These role changes can cause stress in employees by causing role overloads and role conflicts (Türen et al., 2015). In this direction, the interaction of employees with information technologies can result in technophobia by creating negative psychological effects such as anxiety, tension and insecurity (Tarafdar et al., 2007). Tutar and Mutlu (2024) also designed a dynamic scale that would adapt to changes in digital behaviors, evolving technologies, and changing social norms by combining insights from psychology, human-computer interaction, and organizational studies. The digital fatigue scale they developed, based on existing literature on technology-related stress, information overload, and burnout, covers psychological, social, and technological dimensions. Thus, they revealed factors representing different aspects of digital fatigue, such as digital addiction, psychological fatigue, physical-mental fatigue, and psychosomatic problems, which result from prolonged exposure to the screen, cognitive load, emotional exhaustion, and blurring of boundaries between personal and digital life.

On the other hand, Tarafdar et al. (2011) collected technostress-creating conditions in five dimensions. These technostress dimensions are: Techno-overload, techno-invasion, techno-complexity, techno-uncertainty, and techno-insecurity. Techno-overload is felt when employees have to work harder and faster. This can lead to tension and fatigue due to information overload, interruptions, and multitasking. Techno-invasion is the frustration and stress experienced when accessibility and constant connection from anywhere and anytime interferes with personal time and places outside of work life. Work-related technology addiction invades the privacy of family and private life. Techno-complexity occurs when employees find the use of technology complex and feel inadequate about their technological skills. This feeling also creates stress as it takes more time and energy to understand the

technology. Techno-uncertainty is the discomfort with the ever-changing nature of information systems. Since the rate of change of technologies and applications is high, the existing knowledge of the employees is rapidly losing their validity. Although employees are initially enthusiastic about learning about innovations, the fact that they have to constantly update themselves is a cause for concern. Techno-insecurity reflects the tensions of employees to lose their jobs to other people who know the technology better than themselves. In other words, it describes the stress experienced under the threat of losing one's job. In this context, when the differentiated nature of teleworking from office work cannot be managed effectively, it is inevitable to create technostress-creating job demands for employees (Weinert et al., 2014).

2.3. The Job Demands-Resources (JD-R) Model

One of the comprehensive models used to evaluate the effects of different teleworking factors on the job outcomes is The Job Demands-Resources (JD-R) Model (Nakrošienė et al., 2019; Wang et al., 2022). Every work environment has its own unique job demands and job resources that have a significant impact on organizational outcomes. Job demands refer to the physical, social or organizational aspects of the job that require sustained physical or mental effort and are therefore associated with certain physiological and psychological costs. Factors such as physical workload, time pressure, recipient contact, physical environment, and shift work constitute job demands. Job resources, on the other hand, indicate opportunities and gains that reduce the physiological and psychological costs of job demands and enable employees to achieve successful results. Physical, psychological, social or organizational aspects, such as being functional in achieving job goals and promoting personal growth and development, fall within the scope of job resources. Factors such as feedback, rewards, job control, participation, job security, and supervisor support are examples of job resources. Extreme job demands, exhaustion, lack of job resources can cause disengagement. Therefore, it is claimed that the interaction between job demands and job resources plays an important role in the development of burnout (Demerouti et al., 2001). In this context, it is of great importance for organization managements to be aware of the potential of job resources to buffer the effects on job demands, in order to cope with stress reactions, including burnout (Bakker et al., 2004).

With the increasing use of technology in the business world, technology-related job demands increase. At this point, technology-related role ambiguity and role overload trigger the emergence of technostress (Akyol, 2023). Within the scope of teleworking, technostress can be considered as a job demands. This is because when employees perceive techno-stressing conditions such as techno-overload, techno-invasion, techno-complexity, techno-uncertainty, and techno-insecurity, they have to exert more physical and/or psychological effort to cope with this technology-related stressor (Wang et al., 2022). In addition, it has been observed that the sudden transition to teleworking, especially during the COVID-19 period, triggers technostress in employees who are accustomed to working in a traditional style. Because, for employees who are accustomed to working in an office environment,

having to adapt quickly to working from home technologies in such a challenging period has become an extra job demands and created stress. At this point, it is noteworthy that the technostress experienced by the employees at the individual level also causes negative effects in terms of organizational outcomes such as productivity, job satisfaction and organizational commitment (Chakraborty and Kar, 2021). In this research, which is based on such a theoretical framework, it is aimed to examine the studies that deal with teleworking and technostress together with their individual, organizational and social dimensions in a holistic way.

3. METHODOLOGY

In this study, bibliometric analysis techniques were used to examine the research topic discussed in the introduction section. The reason why these techniques are preferred is that bibliometric analyzes provide a systematic, transparent, and repeatable review process based on the statistical measurement of scientists or scientific activities (Broadus, 1987; Diodato & Gellatly, 2013). This method, which is very effective in revealing the performance of articles and journals in academic studies, also provides important information on issues such as collaborations, trends, and the discovery of an intellectual structure specific to a field (Donthu et al., 2021). Thus, in addition to a performance analysis that examines the descriptive components of studies (Ramos-Rodríguez & Ruíz-Navarro, 2004), a science mapping is also performed that deals with the structural connections and intellectual interactions between studies (Baker et al., 2020). When the studies conducted in recent years are examined, it is seen that bibliometric analysis is preferred in many fields from social sciences to engineering (Anuar et al., 2022; Cavalcante et al., 2021; Guo et al., 2019; Homberg and Vogel, 2016; Izzo et al., 2022; Kuzior and Sira, 2022; Liao et al., 2018; Piwowar-Sulej et al., 2022; Shah et al., 2019; Singh et al., 2021; Tamala et al., 2022; Zakaria et al., 2021; Zhang et al., 2022). When the methodological literature of bibliometric analysis is examined, it is seen that there are five different techniques (Zupic and Čater, 2015). It is possible to list these techniques with titles such as (1) Citation analysis, where the most influential publications are identified; (2) Co-citation analysis, in which the relations between the cited publications are examined; (3) Bibliographic coupling, in which the relations between the citing publications are examined; (4) Co-word analysis, in which existing or predicted relationships are explored by focusing on the written content of publications; (5) Co-authorship analysis, in which the social interactions or relationships between authors and their institutions are examined. In this study, co-word analysis was preferred since the content of the publications will also be examined with thematic analysis. Co-word analysis works differently from citation analysis, co-citation analysis, and bibliographic coupling analysis, by examining the actual content of the publication itself. At this point, the main focus of these three techniques is on publications, while the analysis unit of the co-word analysis preferred in the present study is words (Baker et al., 2020; Burton et al., 2020; Emich et al., 2020). Expressing the content and especially the keywords of the publication pool examined within the scope of the study in groups is very important in terms of revealing the relationships and visualizing the areas where the

publications are concentrated (Jotabá et al., 2022). In this study, a software named VOSviewer was used to visualize the relationships of the publications based on keywords (Van Eck et al., 2010). In this application, (1) Co-occurrence and then (2) Author keywords were selected from the application options in order to analyze which keywords the publications focus on.

In the process up to the realization of the analysis and in the next processes, the steps of bibliometric analysis: (1) research design in which the study subject is determined, (2) data compilation in which the filtering process is done by selecting the publication pool, (3) analysis in which the data is grouped through software, (4) visualization in which the groupings are illustrated, and (5) interpretation in which the data is explained and interpreted were used (Zupic & Čater, 2015).

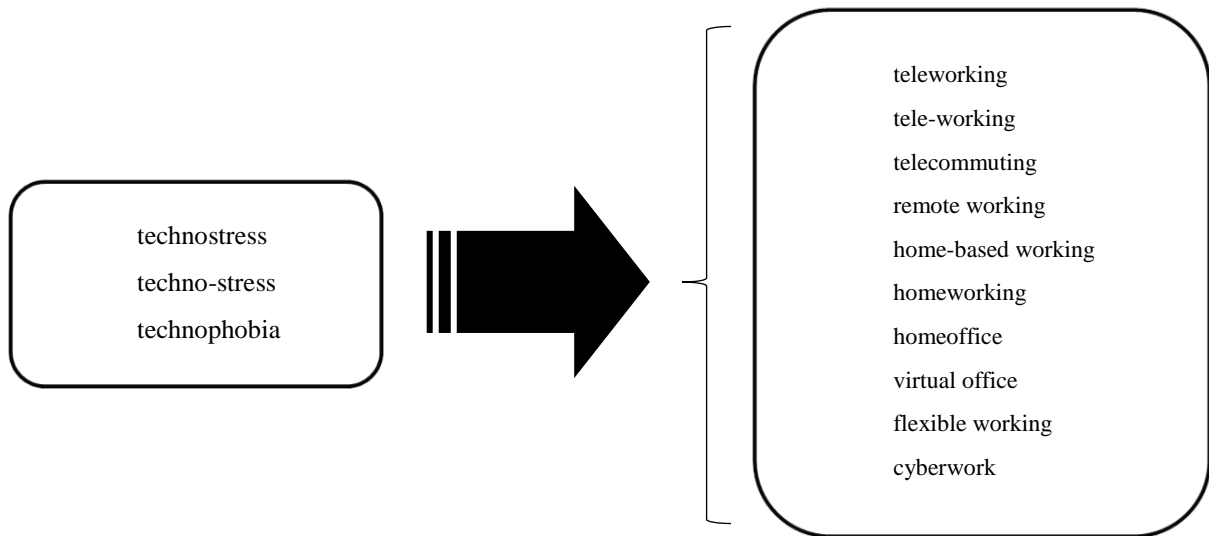
In addition to the processes mentioned above, since this study focuses on the effects of teleworking on technostress, the thematic content analysis method was also used to examine the publications obtained in this field. The thematic content analysis enabled the teleworking effects discussed in the publications to be revealed in the context of technostress by re-reading all the studies in the publication database (Braun & Clarke, 2006). Thus, researchers had the opportunity to obtain conceptual and in-depth insights.

3.1. Compilation of Study Data

The PRISMA technique, first announced in 2009 and revised and updated in 2020, was used to guide the choosing and analyzing of sources of data and records, ensuring that the process is transparent, complete, and adds to the value of the research (Moher et al., 2010). Under the “Methods” topic of The PRISMA statement, a flow diagram was developed depending on the checklist’s “eligibility criteria” and “information sources” headings, and comprehensive explanations were made under the headings “search strategy”, “selection process”, “data collection process”, “data items”, and “synthesis methods”.

Web of Science (WoS) and Scopus databases were chosen to create the publication pool in the research. Since these two databases have their own search methods, two sets of query sentences were created separately for both databases. The reason why the query sentences are in the form of “sets” is to avoid leaving any unexamined publications as a result of the query. Because in the literature, “teleworking” can take names such as “remote working”, “flexible working”, and “homeworking”. Similarly, the expression “technostress” can be referred to as “technophobia” in publications. Basically, the words technostress and teleworking, together with all their other names in the literature, were queried in the aforementioned databases by cross-over method, considering all possibilities. The queries were searched in the “TITLE-ABS-KEY” section in the Scopus database and in the “Topic Search (TS)” section in the WoS database. This field corresponds to the “TITLE-ABS-KEY” field in the Scopus database. The necessity of making the queries specific to this field is to choose keyword analysis as the analysis unit of the research. The crossover patterns of the keywords used in both databases are shown in Figure 1.

Figure 1. Keyword Sets Used in Query Sentences



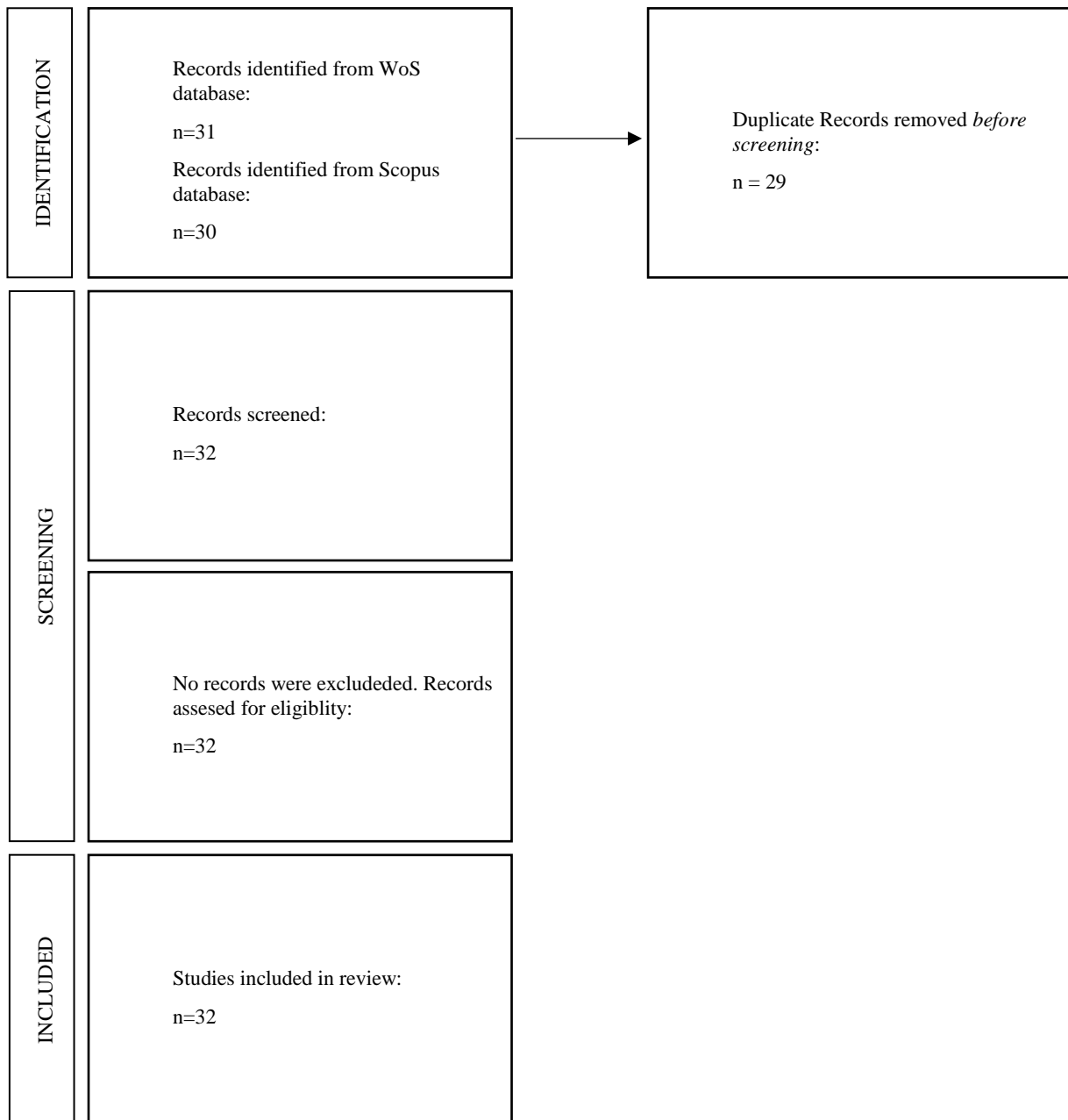
As can be seen from the figure above, the keywords in each set were subjected to an “AND” operation with each keyword in the opposite set, and all the resulting queries were combined with an “OR” operation. An example query sentence for both databases is given below:

For WoS Database: TS=(“technostress” AND “teleworking”) OR TS=(“technostress” AND “teleworking”)

For Scopus Database: TITLE-ABS-KEY(“techno-stress” AND “teleworking”) OR TITLE-ABS-KEY(“techno-stress”AND “telecommuting”)

As it can be understood from the query sentences, no time interval was included in the search criteria in order to reach all studies. As a result of the search, 31 publications in the WoS database and 30 publications in the Scopus database were obtained. After removing duplicate publications among these publications, it was seen that 32 publications constituted the publication pool of the research. Figure 2 depicts the PRISMA flow diagram.

Figure 2. PRISMA Flow Diagram



4. FINDINGS

4.1. Performance Analysis

Within the scope of this analysis, the years in which the studies were published and the citations they received, the research methods used in the studies, and the theories and models on which the studies were based were examined. In addition, another issue addressed in various details is the technostress dimensions of these studies that are examined in connection with the purpose of the current research and the contexts in which these dimensions are discussed.

Table 1. Distribution of Publications by Years

Publication Year	Total Publications (f)	Total Citations (f)
2022	15	42
2021	11	171
2020	6	268
Total	32	481

When Table 1 is examined, it is possible to say that the publications started to take their place in the literature as of 2020 and reached the highest level in 2022 with an increasing research trend. In addition, considering the increase in data, there is a possibility that studies in this field will increase in the coming years. This situation can be associated with the pandemic that emerged all over the world in November 2019. As it is known, the curfews that came with the pandemic and the following understanding of teleworking have led to the emergence of the concept of teleworking in society.

Table 2. Distribution of Publications According to Research Methods Used

Research Method	Total Publications (f)
Quantitative	22
Literature Review	4
Qualitative	3
Mixed	2
Experimental	1
Total	32

According to the data in Table 2, it is seen that the most preferred method in publications belongs to the quantitative discipline. Another remarkable finding is that there is a very important difference between the other methods and the number of quantitative method preferences.

Table 3. Distribution of Publications by Theory or Model

The Underlying Theory or Model	Total Publications (f)
No Theory or Model	18
Job Demands-Resources (JD-R) Model	7
Stressor-Strain-Outcome Model	2
Boundary Theory	1
Conservation of Resources Theory	1
Person-Environment Fit Theory	1
Social Exchange Theory	1
Stress Adaptation Theory	1
Transactional Model of Stress and Coping	1
Total	33

The findings in Table 3 provide information about the theories and models on which the reviewed studies are based. According to the table, while no model or theory was adopted in 18

publications, the JD-R Model was taken as the basis in seven of the studies. According to this finding, it is possible to say that the JD-R Model is the most referenced model in studies.

4.2. Thematic Content Analysis

With this analysis, the contents of the studies were examined with detailed readings, and answers were tried to be found through these readings. The thematic content analysis for studies examining teleworking and technostress together has been deepened in the focus of individual, organizational and social contexts, based on JD-R Model of Demerouti et al. (2001) and technostress dimensions of Tarafdar et al. (2011).

Table 4. Sub-themes Related to the Individual Context Theme

Individual Context	
Job Demands	Techno-complexity Techno-insecurity
Sub-total	14
Job Resources	Information Technology and Teleworking Experience Coping with Covid-19 Anxiety Psychological Resilience Information Technology Awareness
Sub-total	16
Outcomes	Techno-fatigue Strain Unwell-being Mental Health Problems Physiological Health Problems Burnout Workaholism Techno-addiction
Sub-total	62
Total	92

In Table 4, the classification that emerged as a result of grouping the dimensions revealed in the scope of job demands, job resources, and outcomes on the individual context is given. As a result of this classification, it is possible to say that the frequency of the dimensions handled in the individual context from the publications in the database created for this study is 92.

Table 5. Sub-themes Related to the Organizational Context Theme

Organizational Context	
Job Demands	Techno-overload Techno-uncertainty
Sub-total	25
Job Resources	Providing Information Technology Infrastructure and Training Support to Teleworkers Effective e-Leadership Family-responsive Human Resource (HR) Policies Flexible Organizational Culture that Supports Teleworking Providing Organizational Support to Establish a Safety and Healthy Workspace for Teleworking Autonomous Job Design for Teleworking Healthy Intra-organizational Communication in Teleworking Providing Organizational Support for the Development of Teleworkers' Sustainable Change, Time and Stress Management Skills Organizational Justice in Performance, Reward and Career Management for Teleworking Satisfactory Pay and Benefits for Teleworking
Sub-total	60
Outcomes	Job Satisfaction Problems Performance and Productivity Problems Decreasing Intention to Continue Teleworking and Increasing Turnover Intention Increasing Counterproductive Work Behaviors Organizational Problems related to Career Uncertainty Organizational Commitment Problems
Sub-total	33
Total	118

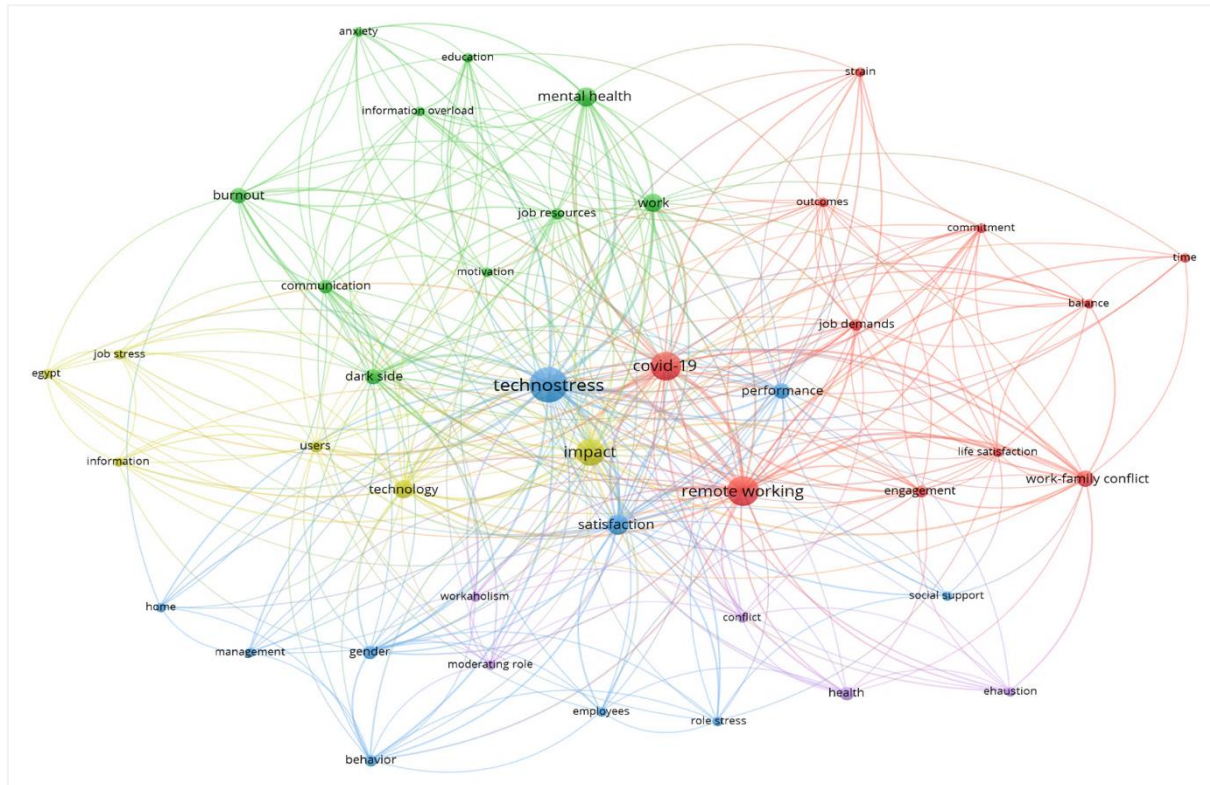
Table 5 shows the classification formed by bringing together the dimensions of technostress associated with teleworking, which form the basis of this study, in the organizational context. In this direction, it has been determined that the frequency of dimensions in the organizational context is 118 in the aforementioned publications. This result is also interesting in that it is higher than both the individual context and the social context as will be indicated in the next table. It can be said that the focus of the studies included in the publication database of this study on the dimensions of technostress associated with teleworking is mostly on the organizational dimension.

Table 6. Sub-themes Related to the Social Context Theme

Social Context	
Job Demands	Techno-complexity
Sub-total	16
Job Resources	Social Policies to Provide Work-Family-Life Balance Social Policies to Provide Women, Youth and the Elderly with the Necessary Support to Improve Their Teleworking Experience Social Policies to Prevent Techno-stressors
Sub-total	7
Outcomes	Work-Family-Life Conflict Decreasing Social Support and Life Satisfaction as a Result of Social Isolation Experiences due to COVID-19 Increasing Role Conflicts in Society Unhealthy Social Communication, Relationships and Decision Making
Sub-total	25
Total	48

Table 6 provides information on the placement of dimensions of technostress associated with teleworking within the scope of job demands, job resources, and outcomes under the heading of social context. The frequency of the relevant dimensions in the social context was found to be 48.

Figure 3. VOSviewer Output of Relationships Between Publications Based on Keywords



The visual in Figure 3, obtained from the VOSviewer software (version 1.6.18, 2022) and showing the relationships based on keyword frequency between the publications, supports the findings of the study. The image shows the circles with the most frequently highlighted keywords relatively larger than the other circles. Accordingly, it is observed that the keywords technostress, teleworking, impact, Covid-19, satisfaction, mental health, work-family conflict, performance, technology, dark side, and burnout are the most frequently studied for these studies. This finding obtained from the image supports the findings obtained from both performance analysis and thematic content analysis. In addition, another remarkable finding is that studies on job resources, job demands, and outcomes keywords are less common than other keywords. From this finding, it can be concluded that it is an appropriate approach to address the outcomes of teleworking on technostress under the headings of job resources and demands in individual, organizational and social contexts in this study.

5. DISCUSSION AND CONCLUSION

Understanding the dynamics of teleworking, which has attracted great interest in terms of ensuring business sustainability in the recent Covid-19 pandemic, is of critical importance on both theoretical and practical basis, due to its potential to be an integral part of the digital working model of the future. In this study, researches examining teleworking and technostress together were reviewed and

integrated in a multi-level manner from the perspective of OB. As a result of the analysis, a holistic analysis with individual, organizational and social contexts was revealed in parallel with the interrelated micro, meso and macro analysis levels within the framework of the JD-R Model.

Before proceeding to the general evaluation of the research results, it should be underlined that no restrictions such as year, country, sector, profession, theory, and research method are placed in the search carried out on the relevant databases for the purpose. As a result of scanning with sets of query sentences on the basis of keywords, it was seen that the publications within the data set cover the COVID-19 pandemic period and beyond. It has been determined that quantitative methods are mostly used in the mentioned publications. In addition, in the examination made in terms of the theoretical foundations of the publications, it was noted that the model with the highest frequency was the JD-R Model. It can be said that this finding is in line with the findings of researchers such as Nakrošienė et al. (2019) and Wang et al. (2022), who pointed out that the JD-R Model is the most common model used to evaluate the effects of teleworking.

The thematic content analysis for studies examining teleworking and technostress together has been deepened in the focus of individual, organizational and social contexts, based on JD-R Model of Demerouti et al. (2001) and technostress dimensions of Tarafdar et al. (2011). In this context, it has been seen that technostress dimensions come to the fore as job demands. This finding is consistent with the findings of Califf et al. (2020) and Wang et al. (2017). Among the five dimensions of technostress, techno-complexity on the basis of lack of technological skills and techno-insecurity on the basis of the employee's anxiety of losing their job to someone who knows technology better than themselves create job demands reflecting individual tendencies. Techno-overload dimension that creates the feeling of working harder and faster, and the techno-uncertainty experienced due to the high rate of change in technologies are organizational-based job demands. Techno-invasion dimension of technostress, which violates the work-family boundaries, is the social-based job demands.

The main and sub-theme groupings at micro, meso and macro analysis levels of job resources that suppress the negative effects of teleworking and technostress are as follows: Four job resources have emerged at the individual level. These are (1) Information technology and teleworking experience, (2) Coping with Covid-19 anxiety, (3) Psychological resilience, and (4) Information technology awareness. At the organizational level, ten job resources have emerged. These are (1) Providing information technology infrastructure and training support to teleworkers, (2) Effective e-leadership, (3) Family-responsive human resource (HR) policies, (4) Flexible organizational culture that supports teleworking, (5) Providing organizational support to establish a safety and healthy workspace for teleworking, (6) Autonomous job design for teleworking, (7) Healthy intra-organizational communication in teleworking, (8) Providing organizational support for the development of teleworkers' sustainable change, time, and stress management skills, (9) Organizational justice in performance, reward, and career management for teleworking, and (10) Satisfactory pay and benefits

for teleworking. At the social level, three job resources emerged. These are (1) Social policies to provide work-family-life balance, (2) Social policies to provide women, youth, and the elderly with the necessary support to improve their teleworking experience, and (3) Social policies to prevent technostressors. At this point, Ollo-López et al. (2021), who examined the usefulness of teleworking on the basis of individual, organizational, and country level factors, emphasized that a participatory organizational culture encourages teleworking. They also stated that Science, Technology, Engineering, Mathematics (STEM) education applications for women can facilitate teleworking. On the other hand, they also drew attention to the importance of issues such as strengthening the information and communication technology infrastructure with both public and private sector investments, the transition to the fifth generation mobile network technologies, the provision of cyber security, the handling of technostress related to teleworking as an occupational health and safety risk, and the making of necessary public regulations regarding the issue in terms of dissemination of teleworking. Belzunegui-Eraso and Erro-Garcés (2020) also listed the factors explaining the teleworking application as individual (personality and situation), organizational (strategy and culture), job (nature and technology), home and family, and environmental (safety, and legal). On the other hand, in the study in which Afshari et al. (2022) used the JD-R Model, emphasizing that employees must cope with intense job demands in a rapidly changing environment due to serious resource losses experienced during the Covid-19 crisis, it was found that the mediating role of perceived organizational support mitigated the negative effects of job demands on employee outcomes. Engelsberger et al. (2022) also emphasized the importance of organizations creating an environment that encourages relational dynamics among employees in order to achieve strategic goals in the presence of virtual work environments such as telework and unpredictable work conditions.

The main and sub-theme groupings related to individual, organizational, and social outcomes of teleworking and technostress are determined as follows: There are eight outcomes at the individual level. These are (1) Techno-fatigue, (2) Strain, (3) Unwell-being, (4) Mental health problems, (5) Physiological health problems, (6) Burnout, (7) Workaholism, and (8) Techno-addiction. There are six outcomes at the organizational level. These are (1) Job satisfaction problems, (2) Performance and productivity problems, (3) Decreasing intention to continue teleworking and increasing turnover intention, (4) Increasing counterproductive work behaviors, (5) Organizational problems related to career uncertainty, and (6) Organizational commitment problems. At the social level, four outcomes were found. These are (1) Work-family-life conflict, (2) Decreasing social support and life satisfaction as a result of social isolation experiences due to Covid-19, (3) Increasing role conflicts in society, and (4) Unhealthy social communication, relationships, and decision making. The main findings of the study by Erro-Garcés et al. (2022), in which the effect of telework experience on well-being through structural equation modeling, both directly and through work-life balance, and job satisfaction confirm the impact of a positive telework experience on perceived well-being only indirectly through work-life balance.

López Peláez et al. (2021) also emphasized that occupational risks of psychosocial nature should be faced especially for employee well-being by drawing attention to factors such as stress, mental health, ergonomics and workload within the scope of occupational risks of teleworking. The study also underlined the critical importance of understanding the social challenges arising from the increase in teleworking practices in terms of business sustainability and employee health and safety.

In summary, it can be stated that the results of the relationship analysis based on keyword frequency, performance analysis and thematic content analysis carried out within the scope of the current research are consistent with each other. At this point, the findings of the research have revealed that technostress poses a dark side to teleworking as an OB challenge stemming from the Covid-19 pandemic. This study contributes to the relevant literature and practice both in this aspect and on the basis of being such a comprehensive and comparative research on the subject. On the other hand, the fact that the data set of the research consists of 32 publications can be seen as a limitation. However, despite the fact that no year, country, industry, profession, theory, or research method limitations were set in the search made on the WoS and the Scopus databases, such a result was encountered due to the fact that the technostress issue of teleworking, which was focused on, was relatively new on the basis of its widespread use with the Covid-19 pandemic. In addition, within the scope of the thematic content analysis, 32 publications were examined one by one with meticulous effort. Therefore, it can be said that the number of related publications is ideal. In future studies, other databases can be searched to present comparative perspectives. In addition to the quantitative trend seen in research trends, integrated mixed method studies including qualitative designs can be carried out in order to present more in-depth inferences on the subject. Moreover, more empirical research is needed, more specifically from the perspectives of employees, due to the critical importance of teleworking applications increasing with the Covid-19 pandemic in future work style scenarios based on digitalization trends in business life. In this context, the potential of the increasing use of digital technology to facilitate and threaten decent work can be revealed through research conducted with different types of digital workers (Nash et al., 2018), such as gig workers and digital nomads. Thus, the aspects of technology that enable and constrain decent digital work can be evaluated based on their effects on different types of digital workers.

In terms of practical implications, teleworking designs should be designed considering that sustainable work in the digital age requires innovative and digital skills. In this context, priority should be given to issues such as investing in teleworking technologies and equipment and providing organizational support during the design of employees' home environments as workspaces. In addition, offering individualized teleworking arrangements to highly skilled creative personnel through idiosyncratic deals (i-deals) (Rousseau, 2005) will be a human resources practice that will encourage the flexible and innovative working system of the 21st century. In addition to all these, there is a need to support technology literacy, digital skills training and digital citizenship with social policies in order to turn the teleworking application, which has become widespread on the basis of a threat perception

such as the Covid-19 pandemic, into an opportunity as the future working style. Moreover, it is important to include technostress connected to teleworking within the scope of occupational health and safety legislation, such as the ISO 45003:2021 “Occupational health and safety management - Psychological health and safety at work - Guidelines for managing psychosocial risks” standard, especially in the scope of SDG 3, in terms of outcomes for employee well-being. Thus, strategies and policies that will form the basis for the implementation of advancing OB innovations and interventions that care about employees will be able to be created in order to support the health of the workforce, especially in working environments that have become more stressful and challenging conditions due to the use of technology.

The study does not necessitate Ethics Committee permission.

The study has been crafted in adherence to the principles of research and publication ethics.

The authors declare that there exists no financial conflict of interest involving any institution, organization, or individual(s) associated with the article. Furthermore, there are no conflicts of interest among the authors themselves.

The entire study was developed jointly by *Author 1* and *Author 2*. *Author 3* contributed to the compilation of the data. The correction of the study was carried out by *Author 4*. *Author 2* is the Corresponding Author of the study.

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The Arab Spring and Russia's Middle East Policy

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Abstract

Russia's Middle East policy has undergone a significant change following the occurrence of the Arab Spring. The main reason for this change was the new strategic realities created by the Arab Spring in the region. Russia first considered the Arab Spring as a regional domestic issue, but this perspective changed as outside influences became involved in the events. The Western powers viewing the Arab Spring as a new regional political configuration influenced the overall framework of this change. The development that had the greatest impact on Russia's approach to the Arab Spring was the events in Libya. NATO's military intervention in Libya has led to the disruption of Russia's gains in the region. In this context, the Libyan issue has provided an opportunity for Russia to radically reconsider its Middle East policy. Unlike the reluctant and cautious attitude in Libya, Russia's regional policy on Syria has taken a more concrete form. Russia's military operation in Syria can be considered in this context. It is impossible to consider the military operation in 2015 in isolation from the developments that emerged after the annexation of Crimea, which led to Russia's relative international isolation. The paradigm shifts and differences in approach in Russian foreign policy after 2014 should not be ignored within this context.

Keywords: *Arab Spring, Libya, Middle East, Russia, Syria.*



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1. INTRODUCTION

There are important strategic factors that guide Russia's Middle East policies. These factors demonstrate a consistent presence in both historical and mental contexts. During the Tsarist Russian period, the region became an important part of Mediterranean policies. Moreover, it is possible to say that Russia positioned itself as the protector of Christianity in the region. During the period of the Union of Soviet Socialist Republics (USSR), the mechanisms that guided Middle East policies took on a more ideological framework. In this context, the USSR implemented a strategy of evaluating the ideological attitude in the countries that were the traditional sphere of influence of the West in its favor. Thus, the USSR built effective relations mechanisms in the region and had the opportunity to consolidate its presence. In the new conditions that emerged after 1991, Russia tried to follow a regional policy by taking advantage of both the Tsarist and Soviet experience. Russia has adapted to new conditions through various mechanisms since the early 2000s, when regionalization began to increase its determinism in international politics.

The Arab Spring process has significantly altered the operation of these mechanisms and set the stage for the emergence of new realities. Russia's initial reactions to the Arab Spring actually reflected a more neutral perspective. There was a tendency to evaluate this process in terms of the internal dynamics of the region. This perspective has undergone a major transformation with the intervention of the Western powers in Libya. The West's attempts to direct the process have been the decisive factor in this transformation.

The article seeks an answer to the question of which factors determine Russia's view of the Arab Spring. In order to answer this question, the historical, security, strategic, and economic reasons that shape Russia's view of the region have been examined in detail. It constitutes the hypothesis of the article that there has been a fundamental and radical change in Russia's Middle East policy after the Arab Spring. To test this hypothesis, Russia's stance on Libya and Syria was compared.

This article offers a comprehensive comparative historical analysis to examine the transformations in Russia's Middle East policy following the Arab Spring. By investigating historical, security, strategic, and economic factors that shape Russia's perspective on the region, the research adopts a qualitative approach. This includes a detailed historical analysis and a case study comparison of Russia's stance and actions in Libya and Syria, aiming to identify shifts and continuities in its policy post-Arab Spring. This methodology allows the paper to systematically explore the determinants and consequences of Russia's policy changes in response to the Arab Spring.

The article consists of three parts. In the first part, the factors that determine Russia's view of the Arab Spring are examined in a historical perspective. In the second part, the Libyan issue, which is a “warning” in Russia's post-Arab Spring policies, is analyzed in detail. In the third part, the regional

and global effects of the military operation in Syria are examined. In the conclusion part, a general evaluation is made on the subject.

2. FACTORS DETERMINING RUSSIA'S VIEW OF THE ARAB SPRING

The Arab Spring is a common term used to describe the popular uprisings that began in the Middle East in 2010. The inequalities brought about by globalization and the efforts of the political administrations in the Arab world to maintain their existence with old methods are among the main reasons that trigger the popular revolt. The Arab Spring had external as well as internal causes. The geopolitical importance of the region and its strategic natural resources determined the framework of external factors. In this context, it was inevitable that the process referred to as the Arab Spring would turn into a tool of hegemony by non-regional actors. The United States of America (USA) under Barack Obama initially tried to deal with the Arab Spring within the framework of human rights and democracy. However, soon the realpolitik approach became more dominant and the US chose to evaluate the process in its favor. Thus, the United States decided to fully support regime changes in the Middle East. In the meantime, it is worth emphasizing that these regimes have deep-rooted and deep relations with the US.

The Arab Spring was also a process that contained many question marks in terms of Russian foreign policy. Therefore, it would be beneficial to examine the strategic importance and background of the Arab world and the Middle East region in general in Russian foreign policy. In 2021, Russian President Vladimir Putin stated that *“the Arab Spring has brought nothing but tragedy to the region. According to Putin, external actors wanted to use this process in accordance with their objective interests”* (Tass, 2021).

To what extent did the Arab Spring process threaten the Soviet strategy, especially during the Cold War? On the other hand, what were the opportunities that this process provided for Russian strategy? In order to answer these questions, it is necessary to examine the content, parameters and dimensions of Russia's historical relations with the region.

Historically, Russia's relationship with the Arab world has consisted of different stages. Pre-Soviet Russia did not have any great goals and ambitions in the Arab Middle East, except to protect the interests of the Orthodox Church in Palestine. Imperial Russia prioritized its strategic presence in the Mediterranean, Iran, the Caucasus, Central Asia and China (Malashenko, 2013, p. 3). The formation of the USSR led to an increased Russian presence in the Arab Middle East. The region became one of the priority areas of Soviet foreign policy, especially after the Second World War. *“The USSR, with the aim of breaking the containment policy implemented by the USA after the World War II, recognized the anti-imperialist potential in the Middle East, the contradictions in the region and the US foreign policy very well and made good use of the opportunity to enter this geography. The change in the foreign policy philosophy of the Soviet administration after Stalin also played a major role in this.”* (Erdem, 2017, p. 95). *“Soviet Russia, which became involved in the Middle East by supporting Egypt during the 1956*

Suez crisis, later increased its influence in the region by openly backing the Arabs in the Arab-Israeli wars and advocating for a resolution to the Palestinian issue" (Purtaş, 2008, p. 47). The main focus of Soviet policy towards the Middle East and the Arab world was the struggle against the West. In this context, the USSR's approach to the region conformed to the paradigm of the conflict between the bipolar system that characterized the Cold War period (Malashenko, 2013, p. 4).

The most important motivation of Soviet foreign policy in the bipolar international system was ideology. In this respect, the USSR administrations provided open support to the regimes that were close to them politically and ideologically in the Middle East. During this period, the main allies of the USSR in the Middle East were Egypt, Iraq, Algeria and Libya (Malashenko, 2013). During this period, U.S. interests in the Middle East were associated with the solution of three main tasks. The most important of these tasks was to contain communism and Soviet influence in the region. Other tasks were to protect Israel's security and to ensure access to Arab oil (Tsikaidze & Koybayev, 2017, p. 53). However, the process of decolonization of Arab countries and the rising Arab nationalism accordingly put the USA in difficulty. In addition, the Israeli-Palestinian conflict had a framework that challenged American policies. According to the United States, the increasing Soviet influence in the region had the potential to disrupt the implementation of the American strategy during this period (Vorobyeva, 2013, p. 64). During this period, Egypt under the leadership of Nasser, who aspired to lead the Arab world, turned into the main ally of the USSR in the region, mostly for realpolitik reasons. *"The policy of ensuring Egypt's leadership in the Arab world, which was combined with the personal charisma of Nasser over time and gained a doctrinaire aspect with a nationalist and anti-imperialist "pan-Arabist" ideological discourse and then an anti-capitalist "socialist" ideological discourse with the great influence of the rapprochement with the USSR, was an important phenomenon affecting the development of relations with the USSR."* (Erdem, 2017, p. 78). The USSR was ready to spend huge amounts of time, money and effort on Egypt in order to find regional allies against the United States. Therefore, the relationship between the USSR and Egypt was beneficial for both sides. Although the intensity of relations allowed Egypt to develop, it also facilitated the USSR's gains in the international arena (Zubko, 2017, p. 28).

The Baathist regimes that came to power in Syria and Iraq in the 1960s became the most important allies of the USSR. The Arab Socialist Renaissance Party (Ba'ath), founded in Syria in 1947, advocated a regional unity on the basis of pan-Arabism. The main slogan of the party was "unity, freedom, socialism". The Baath Party began its activities in 1954 as an underground organization in Iraq. The Ba'ath Party came to power in Syria in 1963. In Iraq, it was in power from 1968 until the 2003 American invasion (Allahkuliye, 2013, p. 106). It was no coincidence that the Ba'ath Party became the main ally of the USSR in the Arab world. Syria, with its secular regime, was becoming a showcase for Soviet aid and support. In this process, Syria was even more important than Egypt in terms of the USSR's foreign policy. Because even when Egypt was at the peak of its cooperation with the USSR, it was

seeking opportunities to diversify its external ties, which distanced it from the USSR (Zvyagelyskaya, 2015).

“The negotiation process that started with Camp David in 1979 under the patronage of the USA for the peaceful solution of the Palestinian problem led to a gradual decrease in the influence of the USSR in the Arab Middle East” (Purtaş, 2008, p. 47). *“The death of Nasser in 1970 and the normalization of relations with the United States by Anwar Sadat, who came to power in Egypt, dealt a major blow to Soviet influence in the Middle East. As a result of the developing Egyptian-US dialogue, the Camp David Accords were signed between Egypt and Israel in 1979”* (Purtaş, 2008, p. 51). During this period, the regional strategic importance of Syria became even more important for the USSR. As a result of Egypt's U.S.-oriented policies, the USSR's aid to Syria continued exponentially. During this period, Syria became a key country in the region in terms of the Soviet military industry (Kreyts, 2010, p. 7). In 1971, an intergovernmental agreement was concluded between the USSR and Syria on the creation of a Soviet military naval base in the port of Tartus (Tass, 2016). The Tartus base is of great strategic importance in terms of the presence of Russian naval power in the Mediterranean and the Middle East, both historically and in the current context.

However, in the Middle East, the multidimensional model of relations established by the United States with Israel could not be fully applied to USSR-Syria relations. The main reason for this was that the alliances of both the USSR and, in the later process, the Russian Federation in the Middle East were built in the context of the principle of contingency and conditionality. The Russian strategy was motivated by regional interests or the achievement of the goals of the international order (Trenin, 2016, p. 4). An example of this is the implementation of perestroika policies during the era of Mikhail Gorbachev, which led to a significant decrease in military aid to Syria (Kreyts, 2010, p. 7). This has also significantly affected the confidence in the Russian strategy in the Arab World.

Following the dissolution of the USSR, there was a pause in relations with the Arab world and the broader Middle East. In fact, it is impossible to analyze this interruption without taking into account the radical changes in the USSR's foreign policy priorities that occurred during the years of perestroika. The region has lost its importance in the foreign policy strategy of post-Soviet Russia. The reason for this was directly related to the transformation of Russia after the USSR. Furthermore, the change in the priorities of post-Soviet Russian foreign policy played a decisive role during this period. Relations with the West were a priority area in Russian foreign policy during Andrey Kozyrev's time as Minister of Foreign Affairs (1991-1996).

Post-Soviet Russia's efforts to build cooperation mechanisms with Western institutions and the clear character of US hegemony in the international system have guided the basic parameters of this priority. However, since the mid-90s, the Middle East has started to be one of the main agenda items of Russian foreign policy again. The appointment of Yevgeny Primakov as Minister of Foreign Affairs in

1996 was undoubtedly important at this point. With Primakov's foreign policy doctrine, "he declared the opening of the Islamic World and envisaged the initiation of policies that revived historical ties with this geography" (Kolosov & Turovskiy, 2000, p. 7). The doctrine has begun to put forward an alternative understanding of a "multipolar and alternative international system" to the unipolar international system led by the USA. Therefore, the new Russian foreign policy prioritized bringing together the restoration of relations with the Islamic World and the Middle East in general with the discourse of a multipolar system.

With the election of Vladimir Putin as President of Russia, Primakov's foreign policy strategy has gained a sustainable framework. Putin's strategy included emphasizing Russia's special position as a power that could act as a bridge between the West and the Muslim World (Malashenko, 2013, p. 1). The Middle East region was considered within the framework of two parameters (security and economy) in the new Russian foreign policy concept adopted in 2000. The main aspect of Russia's interest in the region during this period was the security factor. The focus was on the potential of the situation in the region to impact the entire world. The objective was to bring stability to the region, and Russia had the potential to play a significant role in the peace process (Konovalov, 2016, p. 94). During this period, Russia's policy towards Middle East peace was shaped within the framework of three main tendencies (Yusupov, 2019, p. 259):

- 1) Russia was trying to play a more proactive role in resolving the Arab-Israeli conflict
- 2) In order to achieve this goal, it was necessary to create a difficult balance between Israel, which has friendly relations, and Syria and Iran, which are important countries for Russian strategy
- 3) Russia adopted a pragmatic, flexible and national interest-oriented approach to the region.

After the security factor, there was the need to protect Russian economic interests in the region. *"Special attention was given to the importance of the "Greater Mediterranean" region as a connecting hub for various regions, including the Middle East, the Black Sea, the Caucasus, and the Caspian Sea basin, in relation to Russia's economic interests"* (Konovalov, 2016, p. 94-95).

Putin's overall goal in the Middle East was to determine Russia's status and role as a major foreign power in one of the world's most unstable regions (Trenin, 2016, p. 1). This goal has started to become more concrete, especially with the new geopolitical atmosphere that emerged in the region after the US invasion of Iraq. This period was motivated by attempts to support Russian influence in the Middle East, nostalgia for Soviet influence, a desire to show that events unfolding in the Islamic world were important to Russia, and strategic national interests, including Russia's military presence in the region (Malashenko, 2013, p. 1).

Relations with Saudi Arabia, where bilateral relations were almost nonexistent due to the Chechen problem, also improved during this period. After the events of September 11, 2001, Saudi Arabia started prioritizing its relations with Russia as its relations with the United States became

complicated and it felt the need to diversify its foreign policy. In 2002, the Saudis declared their readiness to cooperate with Russia in blocking the channels that feed international terrorism and blocking the financial foundations of international terrorism. In 2002-2003, Russian foreign policy became increasingly interested in the Arabian Peninsula, which is strategically rich in oil and one of the most important bridges to the Muslim border. This interest of Russia coincided with the desire of the Gulf countries, as these countries wished to diversify their foreign policies in the face of increasing instability. In 2004, the Lukoil company received a tender for the exploration and development of gas and gas condensate fields in Saudi Arabia. Thus, for the first time, a Russian company began to operate in a region traditionally dominated by Anglo-American companies (Sapronova, 2014, p. 31-32).

Between 2001 and 2008, Russia exploited the rising anti-Americanism in the region to gain a number of opportunities in both security and economic terms. In fact, the dimensions of the relations developed with the Gulf monarchies, which were outside the sphere of influence of the USSR, demonstrated that Russia was adapting to new international conditions.

It can be argued that before the Arab Spring, Russia achieved a series of foreign policy successes, both strategic and tactical, in the Arab Middle East. Strategically, Russia has returned to cooperation mechanisms with countries with which it has traditionally had good relations, such as Syria and Egypt. Russia was one of the mediating countries in the Israeli-Palestinian conflict, and this mediation provided it with important strategic gains. On the other hand, there was strong communication with actors such as Hezbollah and Hamas in the region. *“Russia had a special position in the Middle East Quartet, which included the United States, the European Union (EU), the United Nations (UN) and Russia, regarding the solution of the Palestinian problem. Its relations with Hamas revealed that Russia had different views than the other members of the ‘Quartet’”* (Purtaş, 2008, p. 67).

In tactical terms, Russia began to establish economic-oriented cooperation mechanisms with the Gulf monarchies. Historically, the Gulf was an area where the United States and Great Britain were active. In this context, the Russian strategy considered its presence in the Gulf as an achievement.

During the Arab Spring, Russia's main concern was the dimensions of the US military intervention in the region. For this reason, it had an attitude against foreign intervention (Zinin, 2012, p. 297). Russia was not fundamentally opposed to the Arab Spring but considered this period as an internal affair of the Arab peoples. Russia's view of the Arab Spring was shaped by two main concerns. During the Arab Spring, Russia's primary concern was the dimensions of the US military intervention in the region. For this reason, there was an attitude against foreign intervention (Zinin, 2012, p. 297). The second primary concern was the fear that popular uprisings might extend to the Post-Soviet region, particularly Central Asia (Nikitina, 2014, p. 101). In this context, Russia began to draw parallels between the developments in the Arab World and the color revolutions that had previously manifested themselves

in the post-Soviet geography. This parallel constituted the main framework of Russian foreign policy's cautious approach to the Arab Spring.

The Arab Spring period was also considered as part of the global competition between Russia and the USA. The emphasis was on the US's tactic of excluding Russia from the region during the Arab Spring in this context. (Malashenko, 2013, p. 9). It was widely believed that the United States was directing events in the region through the method of “controlled chaos” and ensuring its own interests. Three main approaches to the role and place of the United States in the events of the Arab Spring were distinguished among Russian expert (Kosov, 2016, pp. 477-478).

- 1) In the first approach, many pundits and politicians considered the Arab Spring as the practical realization of the wave of “color revolutions” and the theory of “controlled chaos.” They stated that the main organizer of these events was the United States. Proponents of this view were committed to the ideology of anti-Americanism, which rose significantly in Russia in the context of increasing Russian-American contradictions after 2008
- 2) The second approach rejected the U.S. involvement in the preparation of anti-regime protests in Arab countries. This approach highlighted the fact that the US was caught unprepared for the Arab uprisings, emphasized that regional actors used the US in line with their own interests
- 3) The third approach drew attention to the role of both external factors and internal political reasons in the events of the Arab Spring. Proponents of this approach argued that domestic political reasons were more decisive.

Think tanks such as Valdai and the Russian International Affairs Council – *Rossiyskiy Sovet po Mejdunarodnym Delam* (RSMD), which played an important role in the formation of Kremlin policies, emphasized the positive aspects of the Arab Spring results in terms of Russian foreign policy. In this context, they highlight that the outcomes of the Arab Spring are generally positive for Russia and suggest that the damage caused by the diplomatic defeat in Ukraine in 2014 can be compensated to some extent (Bordachev, 2021). These positive outcomes have enabled Russia to approach the crisis in Belarus in 2020 with increased confidence, particularly following its achievements in Syria. Combining diplomatic and military success in Syria and adopting a result-oriented approach has been beneficial in the medium and long term (Bordachev, 2021).

Although Russia's annexation of Crimea is a strategic success, it did not fully use the dynamics that emerged in 2014, especially in Donbas, to its advantage because in 2014, it was a less costly process for Russia to take full control of the region. The Minsk process, which emerged later, greatly prevented Russia's military gains from achieving a diplomatic success. By not repeating the same mistake in the Middle East, Russia has consolidated its military gains through diplomatic methods. It is worth mentioning that the Astana platform and similar mechanisms established with Turkey and Iran played an active role during that period.

Another important issue affecting Russia's view of the Arab Spring was the strategic levels and dimensions of its relations with the countries of the region. In this context, there were three types of reactions of Russia against the developments in different Arab countries (Klyayn, 2012):

- In Tunisia, Egypt, Yemen, Bahrain and other countries where opposition protests took place, Russia played the role of a “spectator”
- Regarding the events in Libya, where the conflicts intensified and foreign states were involved, Russia was trying to take a neutral stance by expressing its sympathy for Muammar Gaddafi
- Russia, on the other hand, has taken a very different stance in the conflicts in Syria and abandoned its spectator and neutral position. In this context, it has intervened in the Syrian civil war by confronting the West and some Arab countries.

In summary, it was possible to observe that Russia followed a more cautious and wait-and-see policy at the beginning of the Arab Spring event. Focusing on the political causes of the process, Russia chose to adapt to the new realities that would emerge after the riots. However, due to the growing involvement of Western powers in the region and the evolving geopolitical landscape, particularly in Libya, Russia's stance has undergone a significant change. In light of these changes, Russia has become more actively engaged in order to safeguard the progress it has made in the past. The events in Libya have demonstrated that the Arab Spring was shaped not just by internal factors, but also by external influences.

3. RUSSIAN POSITION IN LIBYA

Historically, it is impossible to consider Russia's interest in Libya separately from the Mediterranean maritime geopolitics. In terms of Russia's presence in the Mediterranean, the partnership with Libya built during the Cold War was quite decisive.

The USSR was the first country to recognize Gaddafi, who came to power as a result of a coup d'état in 1969. The Libyan policy of the USSR was basically a set of relations covering military-technical cooperation. In this regard, the USSR was not the main economic partner of Libya. Moreover, Libyan leader Gaddafi emphasized that they did not have the same ideological framework as the USSR (Al-Ammari & Nikolayeva, 2020, pp. 56-57). Gaddafi had his own “socialist path” that was an alternative to “capitalist materialism” and “communist atheism” (Al-Ammari & Nikolayeva, 2020, p. 58, Egorin, 1999, p. 42). Despite these methodological differences, Libya's closeness to the “anti-imperialist” paradigm made it easier for the USSR to act with an ideological perspective in its policies towards this country. However, Gaddafi was looking for a balance between the United States and the USSR. It is worth underlining that this balance was successfully carried out until Sadat came to power in Egypt (Barmin, 2017). The pro-US and pro-Israel policies of Egypt under the leadership of Sadat were among the main factors that brought Gaddafi closer to the USSR. The rapid increase in US influence in Egypt

prompted Libya to strengthen its defense capabilities, primarily with the help of the USSR. This greatly increased the strategic importance of Libya for the USSR and turned it into one of its main partners in the Arab World. The change in Egypt also increased the ideological consolidation between Libya and the USSR. Relations between the two countries have improved due to their similar views on anti-Americanism, anti-colonialism and the Arab-Israeli conflict (Vysotsina, 2016, p. 115). At this point, the main element in the Libyan policy of the USSR was the construction of military cooperation mechanisms. These mechanisms played a significant role in facilitating the expansion of the Soviet arms industry into the Middle East.

The first significant arms deal between the USSR and Libya was signed in 1974. During the 20 years from 1973 to 1992, about 11,000 Soviet military personnel were on Libyan territory advising the Gaddafi government (Barmin, 2017). In some cases, these soldiers took part in fighting on the side of the Libyan army. In addition, many Libyan military personnel were trained in the military institutions of the USSR. After the dissolution of the USSR, this cooperation continued to a large extent. From 2004 until the 2011 revolution, Russia continued to be the main training center of the Libyan army (Birman, 2017). Thus, military cooperation and coordination starting from 1974 made Libya an important ally for Russian strategy.

The events in Libya, which started in 2011 and continues to be effective today, has deeply affected national and regional dynamics. With the assassination of Gaddafi, the dimensions of the chaos in the country increased and Libya turned into one of the main centers of the global struggle. When the civil war began, Russia was torn between supporting its ally Gaddafi and the West's push for international assistance to the rebels. Russia, using its veto right in the UN Security Council, blocked a number of resolutions that allowed European or NATO intervention in the internal conflict in Libya. In the end, however, Moscow was forced to bow to increasing international pressure to support forces opposing Gaddafi.

On February 26, 2011, Russia joined the embargo on arms exports to Libya. In March 2011, Russia abstained from the UN Security Council vote to declare a no-fly zone over Libya and to allow other countries to take measures to protect the civilian population. This allowed NATO to carry out a military operation in Libya at the end of March (Malashenko, 2013, p. 11). The experience of intervention in Libya under the guise of humanitarian goals has revived the debate about the concept of the “responsibility to protect”, due to which NATO discredits its opinion in this country (Koposova, 2017, p. 7). It was possible to say that a “division of labor” was formed in the intervention of NATO and the EU in the Libyan crisis. In this context, NATO acted militarily and the EU acted as a “peacemaker”, thus implementing a division of labor mechanism. Since the unstable situation in Libya affects European interests rather than the United States, the American administration has refrained from intervening on its own. This situation has pushed European countries to accept their regional responsibilities and to take the lead in resolving the Libyan crisis (Lekarenko, 2021, p. 356). This also

showed that without the military coordination of the USA, the EU had no chance to intervene in the geopolitical crises in the nearby geography. *“In June 2011, the Russian government tried to persuade Gaddafi to resign, but it was too late. Because Gaddafi's opponents did not need any reconciliation with the Libyan leader or his voluntary resignation. The Libyan opposition, with the support of the United States and Europe, was advancing towards victory by force of arms. Thus, Russia, having lost to the West in diplomatic intrigues over Libya, became the 73rd country to recognize the National Transitional Council, which had the upper hand in the fight against Gaddafi. According to Malashenko, such recognition of the new government inevitably affected Russia's relations with Libya.”* (Malashenko, 2013, p. 11)

The superiority gained by the opposition after NATO's military intervention clearly revealed the geopolitical dimensions of the Libyan rebellion. The new Libyan regime quickly began to show signs of dissatisfaction with Moscow. In 2012, the Tripoli Military Court sentenced Russian citizen Aleksandr Shadrov to life imprisonment for “abetting” Gaddafi. There was no longer a power in Libya that expected support from its traditional ally, Russia. Libya is no longer grateful to Moscow for the relief of its \$4.5 billion debt to Russia in April 2008 (Malashenko, 2013, pp. 11-12). The new Libyan administration was convinced that the debt relief action in question was not directed directly against Libya, but specifically against Gaddafi. Russia, which pursued a neutral policy during the events in Egypt, preferred to abstain from the vote at the UN on Libya, losing billion-dollar projects carried out with this country in many areas and completely excluded from the Libyan market (Sotnichenko, 2012). The new Libyan government also did not want to fulfill contracts worth 10 billion USD because Russia had made these agreements with Gaddafi and the new government stated that the agreements could be revised. In this context, Tatneft and Gazprom, Russia's two largest energy companies, had to give up their contracts in Libya. American and European companies have taken the place of Russian companies (Malashenko, 2013, p. 12). The losses of Russian oil companies from the frozen projects were estimated at 100 million USD. At this point, the biggest loss was in terms of Russia's arms sales. Billions of dollars of deals made during the Gaddafi era have lost their validity (Barmin, 2017). Meanwhile, the progress of Russia's infrastructure projects in the country has been disrupted, and as a result, the completion of the Sirte-Benghazi railway section by the Russian Railways Company, spanning 556 km, has been hindered (Zinin, 2016, p. 96).

The passing of UN Security Council Resolution 1973 on March 18, 2011, which allowed for international involvement in Libya and ultimately led to the “regime change” in Libya, compelled Russia to reevaluate its foreign policy in the Middle East. In this regard, the “Libyan scenario” has become the main slogan used by Russia to justify its decision to allocate 700 billion USD for the modernization of the army (Barmin, 2017).

Russia, which is seeking to benefit from the advancements in Libya, has been reminded by this situation that Syria holds an even more special position. Russia has had quite good relations with Syria

for a long time. Its largest diplomatic representation in the Middle East was in Damascus. The naval base, which consolidated Russia's presence in the Mediterranean and the Middle East, was located in Syria. In addition, Syria was an important source of income for Russia in terms of arms trade. "The main concern was that the American army would enter Syria in an intervention similar to the one in Libya. In this case, it would mean that its rival, the United States, would be positioned even closer to Russia" (Sotnichenko, 2012). Russia has taken an unprecedented step in Libya and has not prevented the use of force against a sovereign state in connection with the internal conflict. In this context, the rhetoric of the then Russian President Medvedev did not differ much from the statements of Western leaders (Trenin, 2013, p. 9). Then-Prime Minister Putin, on the other hand, had a more skeptical point of view than other Russian politicians. However, Putin did not object to Russia's refusal to vote in the UN Security Council, and therefore to the adoption of relevant resolutions. However, shortly after this vote, he stated that "the decision allows everything and resembles a medieval crusade" and shared his concerns in this context (Trenin, 2013, p. 10).

All these factors determined Russia's view of the events in Syria. Russia has returned to a strategy that takes into account the political configuration created by the new regional reality brought about by the Arab Spring on a global scale. This strategy has materialized and matured in Russia's policy towards Syria. Russia's operation in Syria was also important in the context of changing the direction, priorities and rational framework of the Arab Spring. In addition, this operation was important in terms of creating a new level of regional security.

4. RUSSIA'S RETURN TO THE MIDDLE EAST: SYRIAN OPERATION AND ITS REGIONAL CONSEQUENCES

There were two important factors that guided the general framework of Russia's involvement in the Syrian crisis. The main of these factors was undoubtedly the new regional conditions brought about by the Arab Spring. The second factor was directly related to Russia's focus on Asian policies due to the Ukraine problem after 2014. After the annexation of Crimea, the main priority of Russian foreign policy was to develop military, economic and political relations with the non-Western world. In this direction, it was aimed to address relations with Eurasia, Asia-Pacific and the Middle East in a new strategic dimension.

The Syrian crisis had a framework that most affected the regional and international balance of power during the Arab Spring events. After the overthrow of Gaddafi and the dissatisfaction of the new Libyan government with the Kremlin, Syria remained Russia's only friend in the Middle East (Malashenko, 2013, p. 12). In this context, Syria had become Russia's main strategic target in the region. In line with this strategic goal, Russia has taken a clear position on Syria from the very beginning. The main indicator of this clear position has been that it does not hesitate from sharp disagreements with the United States and Europe (Trenin, 2013, p. 5).

It can be argued that the air operation launched by Russia on September 30, 2015 covers many goals and objectives. Matsuzato formulates these goals and objectives as follows (Matsuzato, 2022, p. 112):

- Preventing the spread of ISIS and similar fundamentalist radicalism from Syria to Russia's borders
- Offering an alternative to the U.S.-led war on terror in the Middle East, thereby challenging unipolarity
- Laying the groundwork for domestic populist rhetoric that Russian President Putin can use in domestic politics
- Breaking Russia's international isolation after the annexation of Crimea
- Saving the government of Bashar al-Assad, Russia's ally in the Middle East.

Syria had a different position compared to other Arab countries. This difference determined the boundaries and framework of the events that began in Syria in 2011. Undoubtedly, Russia's military operation was key to the preservation of the Assad regime. However, unlike Iraq and Libya in particular, al-Qaeda-linked structures were not active in Syria. Therefore, attempts to divide Syrian society along ethno-sectarian lines ended in failure. In the case of Iraq, the ethno-sectarian divide was much more pronounced. Another important factor was the attitude of the structures in the Assad regime. "During the 2003 invasion of Iraq, the U.S. managed to buy off the generals in the army altogether, so that the Iraqi army could not put up any serious resistance except individually and subordinately. In Syria, this did not happen. Although there were those who acted contrary in the upper echelons of the military-political administration in Syria, this situation was not as important and decisive in terms of numbers as in Iraq" (Koshkina, 2015, p.10).

One of the primary reasons for Russia's involvement in Syria was the presence of ISIS in the region. Long before Russia's military operation in Syria, ISIS militants began posting videos accusing Moscow of supporting the Assad regime by supplying it with weapons. *"One of the videos showed a Russian-made Syrian military plane captured by militants. In addition, the militants were executing Russian 'spies' in Syria in front of the cameras. ISIS claimed responsibility for the terrorist attack on a Russian airliner in the skies over Egypt that killed 224 people, prompting further discussion of the issue of ISIS in Russia"* (Tsurkan, 2016, p. 103).

Another important parameter that guided Russia's involvement was the fact that the crisis in Syria significantly affected the balance of power in the Middle East. Before the events of the Arab Spring, Iraq and Afghanistan, only the United States stood out as the main external actor in the region. The strengthening of the regional position of the United States took place after the events of September 11, as part of the beginning of the "global war on terror" and interference in the internal affairs of Iraq and Afghanistan (Vakhsiteh, 2018, p. 36). In this context, the US was turning the "war on terror" into a

tool to establish regional hegemony. The discourse of the “war on terror”, which was a continuation of the unipolar international system formed after the Cold War, basically had a content that reinforced the regional and global interests of the USA. In this context, Russia has started to emphasize a mechanism of struggle against ISIS and other similar organizations as a way to provide an alternative to the discourse that the USA uses as an effective tool. The Syrian field had a suitable ground for the use of this discourse. The active role of ISIS and similar radical elements in Syria in 2014 allowed Russia to produce an alternative to the American-oriented “war on terror” discourse. Moreover, this alternative discourse was a reaction against US-centered unipolarity.

The Syrian crisis has helped Russia to get out of the geopolitical isolation formed after the annexation of Crimea and to increase its influence on the processes in the Middle East region. The operation in Syria was the first military mission carried out by Russia outside the post-Soviet space after Afghanistan, in which the potential of the Aerospace Forces, Navy, Special Forces and military police was used simultaneously (Vakhsiteh, 2018, p. 41) In this regard, it was of particular importance from the point of view of modern Russian military history.

It can be argued that the annexation of Crimea in 2014 and the military operation in Syria in 2015 contributed greatly to the consolidation of the strategic character of Russian foreign policy. It is impossible to consider these two strategic events separately from each other. Therefore, the annexation of Crimea and the military operation in Syria appear as an example of complementarity and mental continuity. These two important strategic facts are among the most striking examples of the change in Russian foreign policy priorities (Myasnikov, 2020, p. 14). Another important point is that the actions in Syria were carried out without the approval of the UN Security Council, of which Russia is a permanent member (Myasnikov, 2020).

In the short term, Russia's air operation in Syria has become a means of achieving a number of important “instrumental” goals that are not directly related to Syria and go beyond the Middle East region. First of all, the military operation in Syria has brought Russia back to the forefront of world politics. Despite the deep crisis between Russia and the United States after the annexation of Crimea, especially the opposition to ISIS has provided cooperation opportunities as a common concern of these two countries (Stepanova, 2016, p. 1).

From time to time, the two countries have cooperated in the field of Syria, either tacitly or to a limited extent. This cooperation is not limited to cooperation in the fight against the terrorist organization ISIS. For example, support for terrorist organizations such as the PYD and YPG can be considered in the same context. Undoubtedly, it is worth underlining that the support given by the USA to these two terrorist organizations is more comprehensive and decisive. Another important issue is that, unlike the USA, Russia has established mechanisms with regional actors. The Astana platform, which prioritizes the political solution of the Syrian issue, is particularly important among these mechanisms. Russia,

together with Turkey and Iran, has prioritized the functionality of the platform in question and its transformation into a regional mechanism. Because, unlike the USA, which controlled the region for a long time, it is a reality that Russia needs new cooperation and partners more in the eyes of states. In the following period, Russia aimed to create Syria-based cooperation mechanisms with China strategically and with the Gulf countries in a tactical context. In particular, the development of relations with Saudi Arabia, Qatar and the United Arab Emirates has prioritized the elimination of the differences of opinion and essentially strategic differences that emerged during the Arab Spring events.

Another dimension of Russia's strategy to protect the regime in Syria was to prevent the erosion of the secular regimes that existed in its immediate vicinity, especially in Muslim Central Asia. Especially since the mid-1990s, Russia has considered the protection of secular regimes in Central Asia as a priority for its regional policies. In this context, it certainly did not want the change in Syria to become a wave and extend to Central Asia.

The large-scale changes in the domestic and foreign political structure in the Middle East, called the Arab Spring, coincided with Russia's return to the great world politics. In this context, the Syrian operation has played a much bigger role in strengthening Russia's global position than the reaction to the events in Ukraine or Georgia in 2008. According to Bordachev, Russia responded to the hostile actions of Western countries in Ukraine and Georgia and, in fact, waged a defensive struggle against its immediate surroundings. In Syria and, later, in Libya, Russia has demonstrated its ability to project its national interests and values far beyond the modest sphere of influence it has left since the Cold War (Bordachev, 2021).

5. CONCLUSION

The Arab Spring events has basically emerged as a result of intra-regional dynamics that have accumulated over the years. However, it should be emphasized that the event has a dimension of external factors. With the beginning of the events, the US and European powers, which have interests in the region, have attempted to intervene in the events in some way. These initiatives significantly affected the general course of the internal dynamics that emerged in the Arab Spring and even guided the shaping of the process. In a region such as the Middle East, which has been the geopolitical area of interest of great powers throughout history, the determinism of external factors is a very natural process. This decisiveness has caused the development direction and agenda of the Arab Spring to evolve into an external process.

Although Russia initially considered the Arab Spring as a regional and internal issue, it started to act with great power concerns in the following periods and handled the events from the perspective of national interest. It is possible to formulate the basic framework of Russia's view of the Arab Spring and the strategic consequences of this framework as follows:

- Russia has seen the developments in the Middle East in the context of global competition as part of the existing geopolitical and geo-economic struggle with the United States
- It has observed that the regional relations that Russia has built during the Soviet period are under threat, and it has become necessary to create a policy in response to this
- Russia has considered the spread of various groups, which started to gain strength in the region with the Arab Spring, to its own lands and nearby countries as a security problem
- It determined that the stance in Libya harmed Russia's regional strategy and tried not to repeat the same mistake in Syria
- The military operation in Syria contained elements that were a response to Russia's encirclement and isolation by the West due to the annexation of Crimea
- The Syrian involvement has prepared a suitable ground for Russia to consolidate its strategies in the Mediterranean, Africa and the Black Sea

In the post-2011 foreign policy debates in Russia, the view prevailed that the attitude and abstention exhibited in Libya destroyed regional national interests. In this context, it would not be wrong to say that the military operation in Syria eliminated the “passive” and “cautious” situation displayed towards NATO's intervention in Libya and thus allowed Russia to return to the Middle East.

The study does not necessitate Ethics Committee permission.

The study has been crafted in adherence to the principles of research and publication ethics.

The authors declare that there exists no financial conflict of interest involving any institution, organization, or individual(s) associated with the article. Furthermore, there are no conflicts of interest among the authors themselves.

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Contrasting Democratic Trajectories: A Comparative Analysis of Costa Rica and Nicaragua

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Abstract

The main focus of this paper is the democracy process in Central America. It is a case study focuses on Costa Rica and Nicaragua and its respective trajectories towards democracy. Despite their shared historical backgrounds, culture, similar size, and geographical location, Costa Rica has one of the most peaceful and enduring democracies, while Nicaragua has been a tumultuous country with internal conflicts that have directly impacted its democratization. The historical context of colonial exploitation, socio-economic disparities, and political unrest has significantly shaped the contemporary political landscape of the region. This research uses Costa Rica and Nicaragua as examples to highlight the diverse paths of democratic development in Central America. Since 1948, Costa Rica has been a democratic country, while Nicaragua has undergone a dual transition, one through revolution (1984) and the other through democratic elections in 1990. By emphasizing the unique historical peculiarities of the region, valuable insights into the democratization processes are provided. The study uses a historical method to analyze the democratization processes in Costa Rica and Nicaragua. It examines the impact of the conquest period, the role of key factors such as landed oligarchies and military forces, the influence of international economic crises, and the current democratic quality in both countries. The study shows that historical legacies have lasting effects on democracy.

Keywords: *Democracy, Central America, Regime Change, Historical Approach*



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1. INTRODUCTION

Historically, the Central American region comprises five nations: Costa Rica, El Salvador, Guatemala, Honduras, and Nicaragua. Although Belize and Panama are geographically located in Central America, the region is often defined by these five nations due to their shared colonial and post-colonial heritage. This heritage is distinct from Belize's British colonial past and Panama's historical ties to South America (Booth, 2000). The isthmus countries have drawn attention because of their high rates of poverty, inequality, corruption, violence, and migratory waves. The population of Central America is estimated to reach 57.5 million inhabitants in 2024. Geographically, Central America is in proximity to the United States and has been a geopolitically contested region. The democracies in Central America emerged after the violent overthrow of military regimes.

This paper contributes to the existing literature on regime change in Central America by focusing on two countries in the region: Costa Rica and Nicaragua. Despite being in the same region, sharing borders and a similar history Costa Rica and Nicaragua have become two quite different democratic regimes. Nicaragua, on the one hand, is in the process of de-democratization, while Costa Rica, considered the most stable and old democracy not only in the Central American region but also in the Latin American continent. The comparison between two countries under similar circumstances allows for a deeper and more detailed comparison of their respective democratic developments.

In the context of the comparative study of democracy, the historical approach provides an in-depth perspective on the antecedents that have been significant in the political and social evolution. The historical method allows us to understand how past events, such as colonization, independence and foreign interventions, have influenced democratization. This paper analyzes how these events have shaped the consolidation or weakening of democracy in Nicaragua and Costa Rica. By comparing the democratic trajectories of the two countries, it is possible to identify significant similarities and differences in their political and democratic evolution.

The historical approach challenges the common notion of treating a region as a homogeneous entity. Studies of democratization in Central America are presented within the broad panorama of Latin America, thus obscuring exceptional events that have occurred only in Central America.

With this in mind, this study examines the state of democracy in Central America, focusing on the cases of Costa Rica and Nicaragua. The main research question of this study is: How have Costa Rica and Nicaragua developed different democratic trajectories despite their shared historical background and geographic proximity? Related questions include: How did historical events and critical junctures influence democratic development in Costa Rica and Nicaragua? The study relates to existing debates in several ways. First, it contributes to the literature on regime change in Central America by focusing on two contrasting cases within the same region. It employs a historical approach to democratization, aligning with scholars such as Capoccia and Ziblatt who advocate this method in

comparative studies of democracy. Second, the research engages with the concept of the “regional turn” in democratic studies, emphasizing the importance of the regional context in understanding democratization processes. The research provides a comprehensive analysis of the various factors influencing democratization, including colonial legacies, economic reforms, social class dynamics, and international influences, contributing to a more holistic understanding of democratic development in Central America.

The article is divided into five sections. First, this section presents a literature review and historical framework. In the second section a comprehensive analysis of the period of conquest in Central America and its impact on the economic, social, and political configuration of the region is undertaken. The third section is devoted to an examination of the main actors involved in the democratic formulation of the region, with special emphasis on the role of the landed oligarchies and the military forces. The fourth part of the study focuses on analyzing the impact of the international economic crisis on democratic development. Finally, the fifth section assesses the current quality of democracy in Nicaragua and Costa Rica. The concluding section presents a synthesis of the most significant findings concerning to the understanding of democracy in Nicaragua and Costa Rica.

2. LITERATURE REVIEW AND THEORETICAL FRAMEWORK

The historical method is an academic approach that examines and interprets political processes and events throughout history. Capoccia and Ziblatt (2010) suggested the historical approach to deepen the comparative study of democratization. This perspective suggests that history is not always a straight line, but marked by crises and events that shape a country’s political landscape.

Within the historical method, it is essential to consider the concepts of ‘historical juncture’ and ‘critical juncture’. ‘Historical junctures’ refer to events and developments in the past that have a crucial impact on future outcomes, while ‘critical junctures’ are “events and developments in the distant past concentrated in a short period, which have a crucial impact on outcomes later in time” (Capoccia, 2016, p. 89). Path dependence is a concept related to historical and critical junctures. It means that past events and political decisions influence subsequent events and decisions. These concepts are essential to understanding how historical events and critical moments have shaped the political trajectory of countries such as Nicaragua and Costa Rica, influencing their democratic development and the configuration of their current political systems.

While the historical method represents an opportunity to look at democratization processes from a new perspective, its very strength can become a weakness. Møller and Skaaning (2012, p. 79) use a metaphor to illustrate this when he comments that “the view of the forest will blind us as to the contours of the individual trees.” From this perspective, there is an emphasis on analyzing democracy considering the global trend towards its spread, conceptualized as waves of democratization, but the regional level must also be considered. On another occasion, the author emphasizes the limitation of the historical

approach, which does not facilitate the identification of general patterns of democracy and regularities and may overestimate the role of contingency and actors' decisions (Møller, 2012). By acknowledging these critiques, this study aims to provide a more balanced analysis, recognizing both the strengths and weaknesses of the historical approach.

Several studies have used the historical approach to analyze democracy in Central America. For example, James Mahoney (1991, 2001, 2001a) has made a historical analysis of the region, highlighting the importance of the liberal economic reforms of the nineteenth century that have generated divergences in the political trajectories of the countries of the region. Baloyra-Herp (1983) has also carried out a socio-historical analysis to explain the different regimes established in Central America, highlighting that the political divergence in the countries of the region results from dominating of the landowning oligarchy and its subsequent alliance with authoritarian regimes or military leaders to secure their power. On the other hand, Robinson (2003) focuses on the economic development of the Central American region, examining the historical process that took place, transforming an indigenous peasant economy to one based on exploitation and wage labor on coffee and banana farms. Jeffrey (2014) explores the ideological connection between mestizos and Indigenous people, who have come together to organize protests and social demands, becoming the main actors who confronted the established military regimes.

In addition, this work aligns with the line of studies that advocate for a 'regional turn.' The 'regional turn' within the historical approach stands out as a fundamental perspective in the study of democracy (Bermeo & Yashar, 2016). In this sense, the study of democratization in Central America is unique and requires an assessment that considers global processes of democracy as well as regional examples and individual case studies. This becomes even more evident when considering, for example, the complexity of the regime changes that took place in the region. Booth (2020) proposes for the Central American case nine different types of regimes in the region: military authoritarian, personalistic military, military-transitional, civilian-autocratic, civilian-transitional, civilian-democratic, revolutionary, revolutionary-transitional, and semi-democracy. Under this perspective, it is appreciated that Nicaragua is the only case in the region that has had a personalistic military regime; political control was in the hands of the Somoza family, in alliance with the military and key individuals from the financial sector, and has experienced at least five regime changes between 1970 and 2019. Since 2016, it is considered a civilian-autocratic regime, i.e., “dominated by a single person or narrow coalition (supported by a dominant political party and security institutions subservient to the ruler), limited to no checks or balances to executive power, and uncompetitive elections” (Booth, 2020, p. 30), while Costa Rica has maintained since 1970 a civilian democratic regime, that is, a political stability of more than five decades under this conceptualization, which refers to “having elected, civilian, constitutionally restrained governments, broad ruling coalitions, and political competition open to parties from left to right” (Booth, 2010, p. 29).

The regional perspective challenges the tendency to treat Latin America as a homogeneous entity and underscores the need for specific models due to the differences in historical processes experienced at the regional level. This uniqueness has often been overlooked in the more general academic literature on democratization and political regimes, highlighting the unique and valuable contribution that this Central America-focused study can bring to the field of study of democracy.

The literature that focuses on explaining regime change in Latin and Central America can be divided into three main strands. The first group focuses on regime change with an emphasis on causes, processes, and outcomes. For example, new governments are often shaped by coalitions between the military and middle class. Regimes tend to become more democratic when organized labor or middle-class groups gain enough power to diminish the wealth of established elites (Whitehead et al., 2013). In parallel, explanations that focus on how established regimes interact with the social class structure to influence the formation of new regimes. Moore (1993) and other authors, such as Marini and Sader (1991) and Quijano, Gutiérrez, López, and Wallerstein (1980) argue that the establishment of democracy is intricately linked to the rise of the bourgeoisie. For Moore (1993), the bourgeoisie, with its economic base based on trade and industry, gradually displaces the landed oligarchy, paving the way for democracy. However, a more recent study by Paige (2005) supports Moore's thesis that the landed oligarchy's antidemocratic practices and influences apply to explain the difficult development of democracy in Central America. Whereas Moore's proposal for a transition to democracy 'from above' or through promotion by the bourgeoisie is not feasible as it results from social movements.

The second type of literature emphasizes violence, rebellion, and revolution as catalysts for regime change (Petras & Zeitlin, 1969). Rebellion requires a defined constituency, affected or vulnerable people who organize to change their current situation. Brockett (2019) explains how Central America's agrarian economy, pushed to participate in the global capitalist economy, contributed to widespread poverty and social discontent. This created the conditions for citizens to become motivated and organized to change and attack the regime in power. Tilly (2017) defines rebellion as collective action involving direct confrontation with authority; a revolutionary movement is born out of rebellion. It results from a combination of structural and political factors such as social inequality, political exclusion, lack of institutional channels to give voice to demands, and lack of citizen participation.

A third group of literature on regime change emphasizes the processes of democratization and de-democratization. Within this group of literature, various specific considerations can be identified, such as the quality of democracy. Democratic quality is defined as the degree to which a regime effectively adheres to democratic principles and meets the expectations of its citizens (Diamond & Morlino, 2004). Another way to approach regime change is to analyze when an erosion or regression event occurs, which is referred to as a process of de-democratization, which refers to the process by which a regime previously considered democratic experiences a gradual departure from basic democratic principles, such as respect for civil rights, separation of powers, and citizen participation

(Marti & Serra, 2020). The term de-democratization is used to describe how a political system can move in the opposite direction of democracy.

The Central American region is unique, characterized by the triumph of a revolution in Nicaragua—the second success story in Latin America after Cuba—its status as one of the poorest and most violent regions in the world, and significant U.S. intervention compared to the Southern Cone. These elements require an assessment that considers the fundamental theoretical contributions to a proper understanding of democracy in the region. Various times, the three theoretical currents mentioned above overlap to explain what is happening in the region. Therefore, this paper takes into consideration both an analysis of the past, but also analyzes the present, the quality of democracy in Nicaragua and Costa Rica in the 21st century.

3. CENTRAL AMERICA IN HISTORICAL PROCESS: CONQUEST AND INDEPENDENCE

Spanish rule in the Americas spans over three hundred years of history, from the discovery of the New World in 1492 to the various independence movements culminating around 1821, when several new nation-states became independent. The Spanish conquest had a profound impact and left an indelible mark on the Latin American region (Booth et al., 2020; Goodman, et al., 2019; Walker & Armony, 2000).

Central America includes the territories of countries now known as Nicaragua, El Salvador, Honduras, Guatemala, and Costa Rica. The Spanish began their conquest of these territories around 1520, with the exception of the area that is now Costa Rica, which resisted invasion and settlement until 1560, and its coastal regions were never fully subjugated to Spanish dominion (Matthew, 2022). Spanish colonization brought with it a system of social stratification based on slavery, exploitation, and forced labor of indigenous populations that took root throughout the region and shaped the initial social structures and political dynamics (Cerdas Cruz, 2019). Indigenous societies in Central America had a well-defined hierarchical structure of leadership and social organization where the chief was a prominent figure of order. This type of structure facilitated the implementation of the *encomienda* system by the Spaniards (Cerdas Cruz, 2019). The *encomienda* system comprised assigning a group of natives to a Spanish colonist, who taught them the Catholic faith, protecting them, and educating them in European ways. However, this system soon developed into a severe form of exploitation, enslavement, and abuse. In addition, the colonizers introduced a fundamental change: race as a determining factor in the social hierarchy (Booth et al., 2020). This transformed the pre-existing social order, placing the Spaniards and their descendants at the pinnacle, while relegating the Indigenous and creole¹ to inferior positions. This redefined social and power structures and had two main consequences: 1) it generated highly stratified societies with deep racial and class divisions (Walker & Armony, 2000); 2) the distribution of economic

resources, political, and social administration was left in the hands of colonial and mestizo families. They monopolized power and, during the period of independence, continued to do so until they became powerful oligarchies that would determine the political future of the region (Goodman et al., 2019).

However, because of its geographical characteristics, Costa Rica experienced the conquest period differently. Unlike other countries in the north, such as Nicaragua, which were rich in natural resources for exploitation, Costa Rica lacked such abundance. As a consequence, there was no extreme accumulation of wealth in the hands of a few, nor did it foster extreme social division (Stone & Greenleaf, 1990). Likewise, the conquest of Costa Rica came decades later compared to the other countries in the region. Because of the reduction of the Indigenous population by diseases brought by the colonizers, or their displacement to the central highlands, a racially distinct subaltern class was not established to the same extent in Costa Rica as in other colonies in northern Central America. Rather, locals and settlers forged a system of organization in which different social strata interacted and competed to gain power. In Costa Rica, the absence of a structure based on racial and slave division meant less hierarchical power organizations and, to some extent, more prone to the formation of a more fair and participatory civil society (Walker & Armony, 2000). The experience of the conquest in Costa Rica would have long-term consequences and would be conclusive in differentiating it from the rest of the Central American countries (Booth et al., 2020; Cerdas Cruz, 2019; Stone & Greenleaf, 1990).

Despite achieving independence in 1821, the event was overshadowed by the persistence of socio-economic practices and dynamics inherited from the colonial period, which transformed into new forms of exploitation (Cerdas Cruz, 2019). By that time, the economic and political elites of Central America had already entrenched themselves, concentrating on land ownership. This situation led to the formation of a landowning oligarchy whose power extended beyond land ownership to the exploitation of natural resources and the coercive use of labor, often Indigenous or mestizo. The landowning elite relied on the state to extend their control over land through two main mechanisms: first, land reform, where the state privatized large tracts of land, ensuring the elite's access to the best quality land; second, the provision of cheap labor through systems of debt peonage, insecure labor contracts, and the allocation of land to Indigenous families in exchange for labor for elite landowners (Millett, 2019). These practices not only consolidated elite control over agricultural resources but also perpetuated structures of inequality and labor exploitation, facilitating the spread of anti-democratic regimes. The landowning elite significantly impacted the quality of democratic regimes established in the region by using their influence to reject popular demands for land reform, better working conditions, civil and political rights, autonomy and protection for Indigenous communities, and access to education and social services (Booth et al., 2010). The partnership between the state and the wealthy landowners strengthened their control over society through mutual dependence. Subsequently, the armed forces would also assume a significant role. At first, the military functioned as protectors of the elite,

responsible for preserving social order and using violence to suppress rebellions. As a result, they had public authority and direct control over government administration and security forces (Millett, 2019).

As previously mentioned, Nicaragua experienced the formation of oligarchic groups and military alliances. The region saw the emergence of two opposing political forces: the conservative elites and the liberal elites (Walker, 2000). Conservatives supported a centralized and authoritarian government with strong ties to the Catholic Church and defended the colonial social and economic status quo, while liberals sought decentralized government, representative democracy, and the separation of church and state to break with traditional structures and pave the way for modernization. The two factions in Nicaragua were not divided ideologically, but rather by regional rivalries and power struggles among landed elites. Each faction focused on seeking regional alliances with local caudillos, who mobilized peasants to work the land or support the corresponding faction (Cerdas Cruz, 2019). It should be noted, however, that Costa Rica's situation was peculiar. Under authoritarian leaders such as Braulio Carrillo (1835-1842) and Tomás Guardia (1870-1882), the country avoided the formation of an oligarchy. These leaders pursued progressive policies, such as distributing land to small farmers and confiscating land from landowners for redistribution (Walker & Armony, 2000). The absence of landless laborers hindered the expansion of labor-intensive agriculture and prevented extreme concentration of land and power. This combination of factors prevented the emergence of landowning oligarchies in Costa Rica (Baloyra-Herp, 1983).

4. MILITARY, OLIGARCHY, AND POLITICAL DEMOCRACY IN CENTRAL AMERICA

The relationship between the landed oligarchy and the military forces grew stronger after the colonial era, impacting the democratic development of the region.

During the colonial period, the military forces were weak, but they gained prominence in the period of independence. Not only did the armed forces play a crucial part in the struggle for independence, but they also became the primary institution responsible for defining the identity and political framework of the new countries (Millett, 2019). The army shaped the formation of the new nation-states and became more relevant in the absence or weakness of state institutions. Initially, military power was exercised by individuals acting as leaders of armed groups, known as caudillos, or by members of organized armed forces. These warlords often emerged as charismatic figures whose influence was based on personal loyalty and the control they exercised over armed groups. The pre-eminence of military forces and in some contexts by a military figure as a political actor was reinforced by the political and social instability characteristic of the early post-colonial years, where armies often intervened to fill power vacuum, to protect certain political or economic interests. Political influence and infighting varied in the region, which would determine the development and role of each nation's military. For example, since 1838, Nicaragua experienced eleven U.S. interventions. This extensive experience notably influenced the development and training of its armed forces (Perez & Pestana, 2022).

Foreign forces played a crucial role in shaping the military's role in the Central American region (Goodman, 2019). During the Cold War period, U.S. influence grew significantly in the region (Chavez, 2022). To halt and prevent the spread of communism in the region, the United States often supported authoritarian governments that aligned with its geopolitical interests rather than promoting democratic systems and social reforms (Booth et al., 2020). The long duration of the military regime (1936 to 1979) in Nicaragua is because of U.S. support for Somoza (Perez & Pestana, 2022), through the National Guard, a military group that operated under U.S. orders to maintain political stability in the country (Munro, 1933). Social and political mobilizations led by left-wing intellectuals, peasants, and middle-class reformists were repressed violently by the army.

The democratization process in Central America was mediated by the army, which controlled and limited the transition process in three ways: 1) It limited political participation to opposition parties and organizations that promoted socioeconomic structural changes that threatened its interests. 2) It favored partial and temporary reforms of the political system rather than broad and definitive changes, such as the holding of elections for a constituent assembly, the election of an interim president, and a new constitution, but not the election of a new president or parliament. 3) It sought to maintain the autonomy and absolution of the military, meaning that it limited the control that democratically elected civilian regimes could exercise over the military, such as avoiding accountability for human rights violations committed by the military, not investigating cases of corruption, and keeping control of the military budget in the hands of the military (Blachman & Sharpe, 2019).

The advent of democracy in the region was not driven by a genuine commitment to democratic principles; rather, it was driven by strategic considerations and the perception of potential benefits. Faced with the growing rise of social and armed insurgent movements calling for greater individual rights and guarantees, the elite and military groups adopted a form of pseudo-democratic electoral politics from 1980 and early 1990, where a semblance of democracy was maintained, but with limited participation and accountability (Blachman & Sharpe, 2019). Comparably, authoritarian regimes in the region recognized that, in order to take advantage of U.S. economic aid and secure their power, it was necessary to simulate certain political changes and social reforms (Gobat, 2022). This pragmatic approach reveals how power structures in Central America maneuvered within a changing political framework, seeking to preserve their interests while adapting to internal and external pressures.

Costa Rica stands out from neighboring countries by avoiding the formation of a dominant landowning oligarchy and eliminating the army for social stability. Early independence years saw the rise of agrarian capitalism, notably with coffee cultivation driving the economy (Molina, 2022). Unlike Nicaragua, Costa Rica had unpopulated regions suitable for cultivation, facilitating land acquisition from cooperatives and demanding fair wages to keep workers, thus preventing oligarchic formation (Booth, 2000). Power alternated between military and civilian governments, marked by occasional coups, yet indirect elections and constitutional promulgations were upheld. Notably, Braulio Carrillo's

government in the 1830s introduced voting rights for men and literacy requirements in 1840 to expand the electorate (Booth et al., 2010). By the 20th century, Costa Rica boasted higher literacy rates and a robust coffee industry (Walker & Armony 2000; Molina 2022) The 1940s saw the rise of workers' unions, including communist-leaning factions, culminating in the 1948 Civil War (Booth, 2000). José Figueres's victory led to the National Liberation Party's dominance, which nationalized banks, granted voting rights to women and Afro-descendants, and abolished the army in the 1949 constitution (Molina 2022). Since then, political alternation has prevailed, with the National Liberation Party governing for thirteen terms. In 2022, the Social Democratic Progress Party won the elections, offering a fresh alternative to the National Liberation Party rule (Guevara, 2023a).

5. ECONOMIC CRISIS AND CURRENT SITUATION IN CENTRAL AMERICA

The democratic structure in Central America is strengthened by considering the economic crises of the 80s. The democratic trajectory of the Central American region has been affected by economic conditions as social discontent grew and put pressure on the authoritarian regimes that dominated the political system. The stability of Nicaragua and Costa Rica was influenced by global economic dynamics.

The interdependence of political and economic changes in the region was clear during the significant global economic crisis of 1979, which coincided with the democratization phase of Central America. Booth et al. (2010) argue that the Central American region has historically been susceptible to global dynamics, particularly neoliberalism and globalization. Neoliberalism is characterized by limited state intervention in the economy and a preference for the free market. It promotes privatization and foreign investment while discouraging tariffs and trade barriers (Vilas, 2000). The Central American countries' engagement in the global economy revolves around product exports and attracting foreign investment (Klak, 2014). From the early years of independence to the period between 1840 and 1930, the economy was controlled by established elite groups, limiting the region's economic autonomy (Williams, 2022). This dependence on external markets led to Central America accepting prices dictated by stronger economies, restricting profit margins, and emphasizing cost reduction. The region's economy relied primarily on providing cheap labor, perpetuating authoritarian regimes that ensured low labor costs (Vilas, 2000).

Amidst years of mismanagement and exacerbated by economic crises, authoritarian regimes in the region faced escalating social pressures, prompting the adoption of new economic models to address unrest and calls for change (Williams, 2022). This transition to electoral democracy coincided with introducing neoliberal reforms, offering legitimacy to the emerging democracies, and aiming to tackle economic challenges. During the Cold War era, the United States actively intervened to suppress revolutionary movements and counter communist influence, aligning with democratic regimes (Chavez, 2022). The economic crisis of the 1980s was decisive for the future of democracy and the economy in

the region. As the region was highly dependent on exports and the flow of foreign capital, the economic crisis forced it to rely heavily on international aid. The U.S. Agency for International Development (USAID) was responsible for distributing financial and technical aid in the region (Harrison, 1984). Of the five countries in the region, all received economic aid except for Nicaragua. In 1979, the Sandinista revolution triumphed over the dictatorship of the Somoza family (Vilas, 2000).

Nicaragua began its transition to democracy with the overthrow of Somoza's dictatorship by the Sandinistas in 1979 (Booth, 2000). Drawing on the experience of the Cuban revolution, the FSLN sought to avoid similar mistakes and establish a regime that responded to Nicaragua's domestic and international realities (Booth et al., 2020). This included upholding civil and political rights, avoiding the cult of the political leader, maintaining political and diplomatic relations with all nations willing to engage with Nicaragua, and implementing a mixed economy regulated by the state (Booth et al., 2020).

The Sandinista Period lasted ten years and can be divided into two distinct phases (Booth, 2000b). The first phase was the transitional Government of National Reconstruction, during which the main objectives were to reactivate the economy and achieve social stability after "fifty thousand dead, one hundred thousand injured, and one hundred thousand orphaned" (Charlip, 2022, p. 580). The Sandinistas' efforts led to a reduction in illiteracy, vaccination campaigns, and the elimination of education costs. Despite the economic crisis and recession due to oil prices and the Vietnam War, the economy grew considerably (Booth, 2000). However, international dynamics had an adverse impact on the nation; President Reagan's administration categorized Nicaragua alongside Iran and promised to return them to their zone of influence (Godoy Reyes, 2019).

The second phase, known as the Contra Wars, involved opposition forces, including Somoza sympathizers and former members of the National Guard, who sought U.S. support to overthrow the SFNL (Frances and Alegria, 1983). Various armed groups such as the Nicaraguan Democratic Front and the Democratic Revolutionary Alliance emerged, trained and funded by the CIA (Charlip, 2022). Although these groups never managed to control any territory, they were brutal enough to destroy villages, clinics, and schools, and to torture civilians. Additionally, the U.S. imposed a trade embargo in 1985 (Booth et al., 2020). The Sandinistas had to allocate resources to the military to combat the Contras, neglecting social programs and other essential services.

The 1984 elections are noteworthy. Although the Sandinistas had won the revolution, they legitimized their regime through democratic elections, transitioning to a constitutional government (Walker and Armony, 2000). These elections utilized a Swiss-designed voting system, provided media access to all candidates and parties, and featured three opposition parties, making them technically competitive (Charlip, 2022). Sandinista candidate Daniel Ortega won, and a new constitution was promulgated in 1987.

By the end of 1989, the Nicaraguan economy and society were suffocated by violence, poverty, and instability. The Sandinista regime, having faced various pressures over the past decade, was unable to consolidate its power (LeoGrande, 2019). In accordance with the constitution, new elections were scheduled for the following year, presenting a prime opportunity for U.S. intervention. The U.S. strategy for the 1990 Nicaraguan elections involved either denouncing the electoral laws and conditions to invalidate a potential Sandinista victory or working to ensure a win for Violeta Chamorro, who was nominated by a coalition of 14 micro-political parties. The U.S. assured that the war against the Contra groups and the embargo would end with the opposition's victory, represented by Violeta Chamorro (Charlip, 2022). Daniel Ortega ran again but only received 41% of the vote, while Chamorro secured 55%, thus winning the election.

Under Chamorro's administration, social and economic conditions deteriorated further. Chamorro adopted a neoliberal approach, starting with an agreement with the IMF to secure financing in exchange for implementing structural reforms (Klak, 2014). Government-owned properties were privatized, the agricultural export economy was revived, and both violence and unemployment increased (Booth, 2000). The 1990s elections are crucial for understanding the current state of democratic erosion in Nicaragua (Martí and Serra, 2020). The Sandinistas' defeat at the polls led to factions within the FSLN party and the emergence of the Sandinista Renovation Movement (MRS) party. However, Daniel Ortega remained with the FSLN as secretary general and a perpetual candidate in the next two elections, which he lost to Arnoldo Alemán and Enrique Bolaños. In 2006, Ortega finally returned to power (Charlip, 2022). Changes to electoral legislation in 2010 eliminated the two-term limit for re-election, allowing Ortega to run again in 2011 and win. Ortega was re-elected as president of Nicaragua in the 2021 elections, with his wife Rosario Murillo serving as vice president.

In the 1980s, Costa Rica implemented several structural changes to receive financial support from USAID and other financial organizations such as the International Monetary Fund (IMF), the World Bank, and the Inter-American Development Bank (IDB): reform the banking system to give greater participation to private banking institutions, avoid the acquisition of state-owned firms to cooperatives and non-intervention of national banks in the free repatriation of foreign funds and private corporate funding (Vilas, 2000). Faced with the financial pressure in which Costa Rica found itself, it accepted the conditions imposed by these organizations. In addition, the creation of the Coalition and Initiatives for Development (CINDE) played an important role in the privatization and internationalization of the Costa Rican economy (Molina, 2022).

Costa Rica's economy did not collapse during the economic crisis of 1979 because of the great support of USAID. Furthermore, during the 1980s, it emerged as the country receiving the second-highest level of economic assistance globally, following only Israel (Vilas, 2000). Costa Rica's pro-American stance during the Contra War and other social movements rendered it a strategic ally in the region, thereby making it a consistent recipient of U.S. funds and economic support (Booth, 2000). The

resources received were strategically invested in the development of social security, education, and health sectors. This internal stability, combined with an active network of cooperatives, unions, and civic organizations, was further bolstered by significant savings on military expenditures, as Costa Rica does not have an army. These factors enabled Costa Rica to mold external and domestic pressures through robust institutional and social frameworks. Consequently, a stable economy with a strong emphasis on social welfare facilitated Costa Rica's political and social consolidation within the region, while other nations, particularly Nicaragua, struggled to maintain stability.

6. THE QUALITY OF DEMOCRACY IN NICARAGUA AND COSTA RICA

After a review of their historical trajectories, it is now imperative to assess the current state of these two nations. This section analyzes the democratic quality and current performance of democracy in Costa Rica and Nicaragua.

Democratic quality refers to the extent to which a regime effectively upholds democratic principles and fulfills the expectations of its citizens (Diamond & Morlino, 2004). The weaknesses of democracies in Central America are twofold: first, weaknesses in the mechanisms that pause access to political power and second, in the mechanisms that control political power (Barreda, 2011; Mainwaring, 2003). For this reason, the analysis of democratic quality focuses on the following five characteristics: political rights and civil liberties, government responsiveness, citizen participation, accountability, and the rule of law. The first three dimensions evaluate the mechanisms that pause access to political power, while the last two evaluate mechanisms of political control. These five dimensions are theoretically and empirically interrelated. In order to evaluate each dimension, qualitative and quantitative indicators are analyzed that allow us to appreciate such a complex reality as democratic quality, following the precedents of previous works conducted in Latin America and Central America (Altman and Pérez-Liñán, 2002; Barreda, 2011; Corbetta and Pérez-Liñán, 2001; Levine and Molina, 2007). While not exhaustive, this framework offers a comprehensive evaluation of democracy quality within a polyarchic framework (Dahl, 1971).

Political Rights and Civil Liberties: This dimension focuses on respecting and safeguarding political rights and civil liberties. These are crucial for citizens to exercise their right to vote for their candidates and freely express their political preferences in public spaces. In this sense, data from Freedom House (FH) on the guarantee of political rights and the guarantee of civil liberties in Nicaragua show that although elections are formally held, the abolition of presidential term limits and the enactment of laws such as the Sovereignty Law, which relaxes judicial grounds for detention, have provided the government of Daniel Ortega with the legal tools to arbitrarily detain and exclude the opposition from electoral processes and political affairs (Freedom House, 2023b). These actions represent a significant deterioration regarding essential political rights.

The legitimacy of the 2021 elections in Nicaragua is called into question. The Organization of American States (OAS) shows the lack of conditions for the holding of free and fair elections (Martí et al., 2022). Repression of independent media has intensified, and freedom of expression has been restricted, with media closures and attacks on journalists.

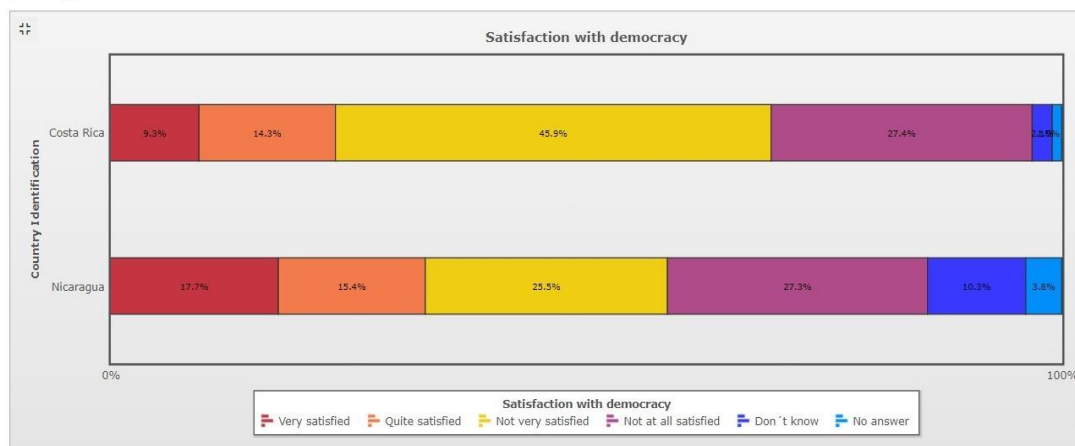
For its part, Costa Rica reaffirms its commitment to democracy, evidenced in the 2022 elections, considered free and fair by an independent Supreme Electoral Tribunal that guarantees fairness in the electoral process (Redondo, 2023). Although the creation of the Presidential Data Analysis Unit (UPAD) raised concerns about state surveillance and improper handling of personal data, its decree was promptly repealed, and civil liberties such as freedom of the press and academic autonomy were institutionalized, highlighting Costa Rica's democratic strength (Freedom House, 2023a).

Both Costa Ricans and Nicaraguans have a perception that addressing their country's problems would have negative personal consequences, Costa Ricans 52.5%, and Nicaraguans 63%, however, Costa Ricans are more certain that there will be no consequences with 44.1% and only 26.5% of Nicaraguans believe that there will be no consequences.

Government responsiveness implies the government's competence to recognize and address citizens' desire and preferences (Powell, 2004). It assesses whether government actions align with citizens' expectations by implementing policies that address their needs (Diamond & Morlino, 2004). To evaluate citizen satisfaction with democratic performance, data from Latinobarometro (2020) surveys are used, capturing satisfaction levels categorized as "very satisfied" or "not at all satisfied."

Graphic 1. Satisfaction with Democracy

In general, would you say you are very satisfied, quite satisfied, not very satisfied, or not at all satisfied with the working of the democracy in (country)?



Latinobarómetro 2020 Costa Rica, Nicaragua
Correlation $r = -0.213$

Source: (Latinobarometro, 2020)

Examining the results of the survey, there is a variety of satisfaction with democracy among citizens of Costa Rica and Nicaragua, reflecting different political and social realities in each country.

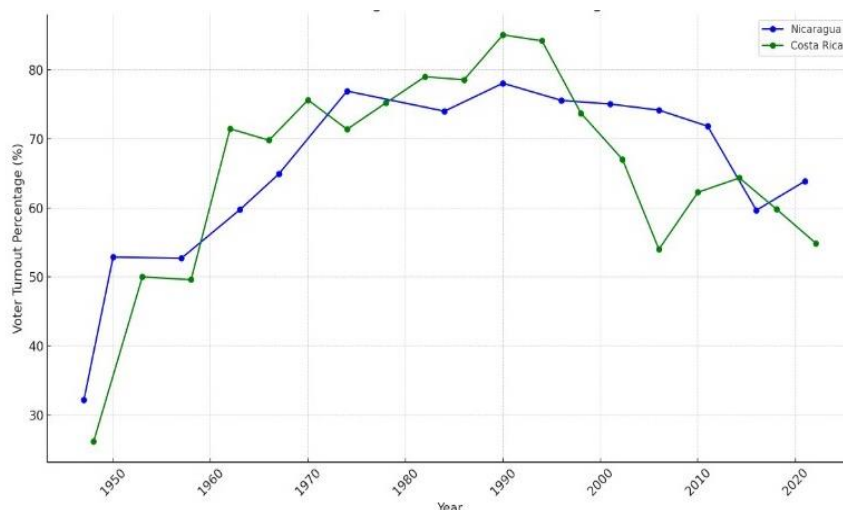
In Costa Rica, 45.9% of respondents say they are "not very satisfied" with the performance of democracy, while 9.3% are "very satisfied." These numbers suggest a moderate level of approval towards democratic institutions and their functioning. However, the 27.4% of the population that is "not at all satisfied" points to a significant sector of society that perceives shortcomings or deficiencies in the democratic system. This contrast might show challenges in areas such as political representation, government effectiveness, or equity in the distribution of democratic benefits. Considering another result of the survey, the above is even more clarifying, since 64.8% of the citizens believe that Costa Rica is governed for a few powerful groups in their own interest, and 49.5% do not trust the government and 60.7% do not trust the political parties. Finally, in 2020 at least 66.7% of the citizens believe that democracy is the preferable regime to any other regime, while in 2023 this confidence decreases to 55.9% and from 2020 to 2023 citizens hold the idea that an authoritarian regime is preferable to a democracy under certain circumstances or even that the regime does not matter.

Updated 2023 data from the Latinobarometro (2020) survey of satisfaction with democracy in Costa Rica, shows a change in the perception of citizens. A notable increase in the proportion of citizens who feel "very satisfied" with democracy, reaching 18.9%, and a majority 40.2% who feel "somewhat satisfied", indicates a positive trend in satisfaction with democracy. In addition, the reduction in the percentage of dissatisfied citizens to 15.3% in 2023, compared to 2020 data, reinforces this observation.

On the other hand, in Nicaragua, the situation is more critical. Although 17.7% of respondents are "very satisfied" with democracy, 27.3% are not satisfied at all. The latter percentage, similar to that of Costa Rica, is accompanied by a lower proportion of satisfaction. Between 2018 and 2020, there was a meaningful change in overall satisfaction with democracy. Specifically, 6.2% of respondents were very satisfied, while 13.4% were somewhat satisfied. Both metrics showed an increase compared to previous years, as shown in the 2020 graph. On the contrary, the percentage of respondents who reported being not at all satisfied decreased from 42.1% to 27.9%. Additionally, at least 44.4% of respondents believe that, despite its problems, democracy is the best system of government, with 11.7% strongly agreeing. Notably, Nicaraguans expressed much more confidence in their government (22.6%) than Costa Ricans did (2.8%).

Citizen Participation: This dimension is crucial to measure the quality of a democracy. Active and extensive citizen participation increases the likelihood that government decisions will reflect the interests of a broader spectrum of the population. The two primary goals of participation are to form a democratic identity and collectively pursue specific interests (Morlino, 2014). One way to evaluate participation is by using the 'voter turnout' indicator. This metric reflects the percentage of eligible citizens who participate in an election and provides valuable insights into the level of civic engagement and trust in the political system.

Graphic 2. Voter Turnout Percentage in Costa Rica and Nicaragua over time



Source: The International Institute for Democracy and Electoral Assistance

Analyzing data from The International Institute for Democracy and Electoral Assistance's (IDEA) Voter Turnout, trends in voter turnout in Nicaragua and Costa Rica unveil intriguing patterns that mirror the evolution of voter participation in both nations. In Costa Rica, voter turnout has remained consistently high, suggesting a stable and engaged democracy.

In Nicaragua, the increase in voter turnout from 1950 to the early 1990s can be interpreted as a period of growing civic engagement, possibly driven by significant political and social transformations, including the Sandinista revolution and subsequent efforts to establish democratic structures (Booth and Richard, 2006). However, after 1990, voter turnout decreased, showing a potential decline in civic engagement and democratic participation. The decline and fluctuations in voter turnout may be related to political disillusionment, especially after the long period of internal armed conflict and the increase in economic problems during the Chamorro presidency. Recently, questions about electoral integrity, changes in electoral legislation, and political crises of representation may have contributed to a decline in citizen trust and participation (Martí et al., 2022).

In Costa Rica, the upward trend in voter turnout until the 2000s reflects democratic consolidation and robust voter participation. Costa Rica is recognized for its democratic stability and effective institutions. However, since 2000, there has been a sharp decline in voter turnout, which may be attributed to a growing disenchantment with the political system. This decline could be because of factors such as perceived corruption, government inefficiency, or a lack of representation in political options (Guevara, 2023).

Accountability refers to the mechanisms that prevent the abuse of power and ensure that no one is above the law (O'Donnell, 2001) Both the government and political representatives are subject to these control mechanisms. These mechanisms include vertical accountability through electoral processes, horizontal accountability through other state institutions, and social accountability through

civil society and individual citizens (Breuer, 2007). Accountability is crucial for effective functioning of a democratic system (Schedler et al., 1999).

In Latin American presidential systems, a widespread practice is the adoption of anti-democratic measures to perpetuate themselves in power (Munck, 2023). A clear example is Nicaragua under President Ortega. This country reflects a significant breakdown in accountability. In 2021, Ortega was re-elected in elections widely considered fraudulent by the international community (Martí et al., 2022). Recent amendments to Nicaragua's Constitution, which have removed the restriction on re-election, have made it easier for President Ortega to assume a fourth term in 2021, continuing his leadership since 2006.

Transparency International's Corruption Perceptions Index shows a negative trend in Nicaragua, which ranked 167 out of 180 in 2022, with a transparency index of just 19 points, pointing to high corruption (Transparency International, 2022b). It is also critical to consider Freedom House's Press Freedom Index to assess social accountability. Since Ortega assumed the presidency in 2006, freedom of expression in general has deteriorated, independent media, journalists, and reporters face threats, censorship, and arrests (Freedom House, 2023b). Similarly, academic institutions have not been immune to government repression. There has been a bias in educational material in favor of Ortega's party, academic censorship, university closures, and, since 2022, a reduction in university autonomy.

Furthermore, individuals are restricted in their freedom of expression. Criticisms expressed on social media have led to arrests, resulting in a rising number of political prisoners. It is suspected that the government is using surveillance technology to intercept private communications on mobile devices, which may explain the rise in the identification and detention of opponents of the regime (Freedom House, 2023b).

In contrast to Nicaragua, Costa Rica presents a different political scenario. Rodrigo Chaves, of the Social Democratic Progress Party (PPSD), won the presidential election, defeating José Figueres of the National Liberation Party (PLN). This event marked a free and transparent election, as well as a competitive transition to an opposition party (Freedom House, 2023a).

Costa Rica ranks 48th out of 180 countries in Transparency International's Corruption Perceptions Index for 2022, with a transparency index of 54 points. This indicates an increase of corruption compared to 2021, when it had 58 points (Transparency International, 2022a). Corruption is a significant issue in Costa Rica and poses a threat to the country's democracy. It is common for candidates and presidents to be investigated for corruption or for receiving improper funds.

The dimension of the rule of law evaluates the quality of democracy based on the existence of a solid legal system that guarantees political rights (Diamond & Morlino, 2004). The rule of law encompasses various sub-dimensions, such as individual security, civil order, efficient policing, and

areas free from the control of organized crime. It also includes freedom from fear and the right to life (Morlino, 2014).

The World Bank provides a Legal Rights Strength Index, which evaluates categories such as the independence of the judiciary, protecting human rights, and freedom of expression. The index also assesses government transparency and accountability, as well as respect for civil and political rights. The index is scored from 0 to 12, with 12 being the highest score. In 2019, Nicaragua scored 2, while Costa Rica scored 10 in the same year's index. Costa Rica has a strong rule of law, with a clear separation of powers and effective judicial independence, which is superior to that of Nicaragua and the global average by 6 points (The World Bank, 2019).

Both countries face challenges to the rule of law and citizen security due to the increase in violence, voluntary homicides, and the presence of organized crime. In 2021, both countries recorded 11 intentional homicides per 100,000 inhabitants (The World Bank, 2021). Costa Rica, a historically peaceful nation without an army, has experienced an increase in violence. This has put pressure on the public forces and control over migratory flows and organize crime. Between 2018 and 2022, an estimated 4% of Nicaragua's population left the country due to political persecution and limited opportunities (Human Rights Watch, 2023).

7. CONCLUSION

This paper has investigated the democratization process in Central America, focusing on a comparative analysis between Nicaragua and Costa Rica. Through a detailed examination of key historical stages, significant similarities and differences have been identified in the political and democratic trajectories of both countries.

From a historical perspective, some observe how events such as colonization and independence have had a substantial impact on the political and social development of Nicaragua and Costa Rica. The importance of considering concepts such as "historical junctures" and the influence of factors such as the landed oligarchy and military forces on the democratic process has been highlighted. These historical junctures have been decisive in the democratic trajectories of both countries, with Costa Rica being recognized as the longest-lived and most stable democracy in the region.

During the colonial and independence period, landed oligarchies emerged in Nicaragua that exerted a strong influence on the political configuration of the country, culminating in a prolonged military dictatorship that ended with the Sandinista Revolution. Despite facing opposition, this revolution generated economic, social and internal political instability, leading to elections in 1990. Those who took part in the revolution are now the main political players, highlighting the intricate and non-linear nature of Nicaragua's democratic process, which is currently in crisis.

In contrast, Costa Rica was more resistant to colonization and avoided a marked class structure because of its scarcity of natural resources. Early economic reforms and land redistribution created a

fairer society with an emphasis on education from its beginnings as an independent nation. The abolition of the army also prevented military authoritarianism, allowing greater citizen participation in the political arena.

Throughout their history, both nations have maintained a dichotomous relationship with the United States that is important to emphasize. While the U.S. supported Nicaragua against communism during the Somoza dictatorship, they provided no support after the dictatorship ended. Costa Rica emerged as the primary U.S ally in the region, receiving significant economic support.

The historical approach employed reveals how past events have shaped democracy in Nicaragua and Costa Rica. The results underline the complexity of political and social processes in Central America, highlighting the importance of addressing regional particularities for a thorough understanding of democratic evolution. It highlights unique challenges such as foreign interventions, economic crises, and social tensions that have impacted democratic quality and political stability.

This study emphasized the need to adopt a region-specific approach to strengthening democracy and addressing social inequalities in Central America, considering the historical lessons and unique contexts of each country.

The study does not necessitate Ethics Committee permission.

The study has been crafted in adherence to the principles of research and publication ethics.

The authors declare that there exists no financial conflict of interest involving any institution, organization, or individual(s) associated with the article. Furthermore, there are no conflicts of interest among the authors themselves.

The authors contributed equally to the entire process of the research.

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How do the Green Energy Stocks React to Green Bond Issuances?

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Abstract

Achieving sustainable development is one of the main issues at the global level and both public and private sector enterprises need to make large – scale investments to fight against climate change. In this respect, green bonds gain importance to raise money for environmentally – friendly projects, especially clean energy. Proceeds from green bonds are earmarked towards financing of investments that have positive environmental impacts. This paper explores the relationship among green bond issuances and stock market reaction with special focus on renewable energy firms. Herein, through a dataset of green bond issuance announcements worldwide by 46 unique firms over the period from 2014 to 2023, we investigate how the share prices respond to such announcements using event – study methodology. From the empirical evidence of the downward stock price movements, we suggest that investors react negatively to the announcement of green bond issuances. In other words, we find significant and negative cumulative average abnormal returns (CAAR) across all the event windows except in the window of [0, 10], meaning that our findings are robust to several alternative event windows. Further, we determine that the share price response, in general, does not differ depending on the use of green bond proceeds and the years.

Keywords: *Green Bonds, Event Study, Stock Market Reaction, Renewable Energy Firms.*



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1. INTRODUCTION

Green finance and green financial products have gained popularity in recent years along with the sustainable development goals put forward by the United Nations. Although the history of green financial products dates back to the early 2000s, green issuances have become widespread after the 2015 Paris Agreement adopted by 195 countries. Nowadays, green financial instruments are vital due to the increasing environmental awareness of firms, governments, institutional investors, managers and regulators. Furthermore, environmental, social and governance (ESG) standards are being integrated into corporate policies around the world.

The main purpose of green instrument issuances is to raise money for projects aimed to tackle environmental problems such as CO₂ emissions and water and air pollution. Firms can issue green products in order to finance their green investments, which consider a set of ESG standards. Although there are many green financial products, green bonds are the most commonly issued among them. Green bond is a sort of fixed-income instrument that provides funding for environmentally friendly projects such as renewable energy production (wind, solar, etc.), sustainable water and waste management, energy efficiency and climate change adaptation (Campiglio, 2016; OECD, 2017; Tang & Zhang, 2020; Suyadal & Yavuz, 2021).

Since the European Investment Bank (EIB) launched the first green bond in 2007, known as a climate awareness bond, the green bond market has grown very fast. Thenceforth, by raising awareness on climate-related risks, many public and private sector organizations have started to issue green bonds. According to the reports conducted by Statista Research Department (SRD), green bond issuances totaled \$633.9 billion in 2021. In 2022 and 2023, issuances decreased slightly, reaching \$554.9 billion and \$619.9 billion. Green bonds were mainly issued in developed countries. USA (\$454.4 billion), China (\$371.9 billion), Germany (\$287.1 billion), France (\$228.7 billion) and international organizations (\$204 billion) are the world's largest issuers of green bonds on a global scale (Climate Bonds Initiative, 2024).

Despite the rising popularity and rapid growth of green bonds, the size of the relevant markets remains small compared to a conventional bond market. Even the same issuer issues the bond, there exists yield differences, so – called greenium, between green and conventional bonds (Löffler et al., 2021; Hyun et al., 2021; Teti et al., 2022) and this can be considered as one of the obstacles to green bond market development. In addition, the absence of global standards, greenwashing and high issuance costs seem to be other possible future threats for those markets (Deschryver & De Mariz, 2020). On the other side, green bonds have portfolio diversification benefits with a low – risk exposure for investors. Green bonds can be a reliable investment option, particularly during extreme market conditions, due to their low correlation with traditional asset classes (Nguyen et al., 2021). Moreover, it is known that issuing green bonds by firms enhances shareholder value (Baulkaran, 2019).

In the common literature, many researchers stated the positive effects of green bond issuances on firm value (Baulkaran, 2019; Tang & Zhang, 2020; Flammer, 2021). The question is, however, whether issuing green bond create value for the green companies generating energy using renewable resources. From that point of view, the objective of the current paper is to investigate the impact of green bond issuance announcements on the stock returns of renewable energy companies by applying an event study approach. With this as motivation, we obtain 156 announcement dates regarding green bond issuances and stock market data of 46 green energy companies. Our findings shed light on the link between green bond issuances and the stock price reaction of renewable energy firms.

The contribution of our paper is threefold. First and foremost, it contributes to the existing literature that examines green bond issuances and their impacts on firm stocks (Baulkaran, 2019; Zhou & Cui, 2019; Lebellet et al., 2020; Tang & Zhang, 2020; Flammer, 2021; Dumlu & Keleş, 2023). Second, it discusses the impact of green bond issuance announcements on share prices, particularly for green energy companies. Lastly, the current study helps generate awareness and enable stakeholders to understand better the dynamics of green bonds.

The remainder of this study is organized as follows. Section 2 presents the relevant literature on green bonds. Section 3 describes the data and details the methodology while section 4 discusses the empirical findings. Section 5 offers concluding remarks. This section also gives suggestions for future researches.

2. INSPIRING LITERATURE

Numerous studies focus on the dynamics of the green bonds in the extant literature. Most of these papers have examined the relationship between green bonds and other financial instruments. For instance, Nur & Ege (2022) reported no volatility spillover between the S&P Green Bond Index and the S&P500 but they observed a unidirectional causality from the S&P500 to the S&P Green Bond Index. Chatziantoniou et al. (2022) investigated the return linkages among the S&P Green Bond Index, the MSCI Global Environmental Index, Dow – Jones Sustainability World Index and the S&P Global Green Energy Index. They confirmed that total connectedness between these indices depends upon economic activities. Besides, the S&P Green Bond Index and the S&P Global Green Energy Index are receivers of shocks while the MSCI and DJ Index transmit shocks for both the short and long run. In a related research, Tiwari et al. (2023) analyze the link between green and green stocks and found a weak connectedness between the two variables during normal times while this relation strengthens during periods of market downturns. Yan et al. (2022) investigated the impact of energy prices, gold prices and green energy stocks on green bond markets using the QARDL methodology. Results showed that strong long – run relationship exists between all variables and green bond markets at a global level. Naeem et al. (2021a) reveal a strong connectedness between green bonds and gold and silver using Diebold – Yılmaz (2014) and Barunik – Krehlik (2018) spillover indices. Su et al. (2023) studied the influence of

oil prices on green bonds employing the quantile-on-quantile (QQ) method and concluded that oil prices positively affect the green bonds in the short – run. Reboredo (2018) claimed that the green bonds are excellent tools in terms of portfolio diversification when combined with stocks and energy market instruments. Likewise, Nguyen et al. (2021) documented that green bonds can be used for portfolio diversification due to their weak correlation with stocks and commodities. Also, Naeem et al. (2021b), Ferrer et al. (2021), Naeem et al. (2022) and Ozkan et al. (2024) emphasize the risk reduction benefits of green bonds. Reboredo & Ugolini (2020) revealed that green bond market is closely related to the conventional bond market and currency market. Similarly, Pham & Nguyen (2021) explored a link between green bonds and conventional asset classes in the US and EU markets. In another research, authors examined the effects of stock volatility (VIX), oil price volatility (OVX) and economic policy uncertainty (EPU) on green bond returns. They found a time –varying connectedness between uncertainty indicators and green bonds (Pham & Nguyen, 2022). Broadstock & Cheng (2019) provide evidence for time-varying relationship between green and conventional bonds. Authors also argue that this relation depends on financial market volatility, economic uncertainty, oil prices and daily news, while Baysan (2019) reported a bi-directional causality between green and conventional bonds. Lastly, Lee et al. (2021) detected a bi-directional causality among oil prices and green bonds. Unlike the aforementioned studies, Hammoudeh et al. (2020) found no causal association between green bonds and other assets, such as conventional bonds and the clean energy index.

Many academic papers examine the yield differences between conventional and green bonds, also known as greenium. For instance, Nanayakkara & Colombage (2019) uncover that green bonds are traded at a premium of approximately 63 bps. Another salient research is Zerbib (2019). Employing a two-step regression approach, the study reported that there is an average negative green premium of 2 bps. A study conducted with a large dataset found a green premium (Löffler, et al., 2021) while Hyun et al. (2021) noted that green bonds have a price premium compared to non-green bonds with the same characteristics. In a similar vein, Hachenberg & Schiereck (2018), Gianfrate & Peri (2019), Kapraun et al. (2021) and Sheng et al. (2021) achieved the same results. Contrary to these findings, Fatica et al. (2021) found no empirical evidence of greenium. They also suggested that investors might not be able to establish an association between the green bond issued by a financial institution and a green project. On the other hand, Dorfleitner et al. (2022) revealed interesting findings about the premium puzzle. Authors found a positive and significant green bond premia. Furthermore, the premium increases with third-party external assessments and investor attention.

Another strand of the literature analyzes the volatility behavior and spillover effects of the green bond markets. Pham (2016) measured the volatility of green bond market using the daily data from the S&P Green Bond Index. Empirical results indicated a high level of volatility clustering in the “labelled” green bonds. Additionally, a shock in the conventional bond markets tends to spill over into the green bond market. Park et al. (2020) confirmed that both green bond and stock markets show volatility

spillover effects while Liu (2022) assessed the factors causing volatility in the green bond market and determined that volatility dynamics of the relevant market are mainly driven by conventional bond, FX and stock markets.

Some of the studies in the extant literature discussed green bonds from the perspective of behavioral finance. In particular, Pham & Huynh (2020) investigated the relationship among investor sentiment and green bond market. Using the Google Search Volume Index and five green bond indices, they discovered that search statistics, as an investor attention indicator, are useful for understanding green bond performance. Similarly, Piñeiro-Chousa et al. (2021) tested the influence of investor sentiment on the green bond market using Twitter data and GMM method to detect a significant positive connection between sentiment and green market. Maltais & Nykvist (2020) conducted interviews to figure out what attracts issuers and investors to engage in green bond market and emphasized that the low cost of capital and low risk of capital are the main factors affecting the green bond market expansion. Sangiorgi & Schopohl (2023) analyzed the survey data to explain the main motivations behind the green bonds issuances. Authors argue that slowing down climate change, sending positive signals to the market and building reputation are important to issuing green bonds. In another study, from the viewpoint of institutional investors, Sangiorgi & Schopohl (2021) stated that aggressive pricing and green credentials seem to be the major determinants of investment decisions in green bonds.

The association between the environmental effects of green bond financing, green bond issuances and firms' environmental performance is also widely probed in the literature. In this sense, Yeow & Ng (2021) investigated the time-dependent changes in the green bond issuers' environmental and financial performance and verified that the certified green bonds are useful financial tools to enhance environmental performance. Fatica & Panzica (2021) provided evidence that the reduction in emissions is consistent with the rise in the number of eco-friendly projects financed by green bonds. In addition, green bonds with external review as well as those issued after the Paris Agreement have a large impact on emissions. The study by Chang et al. (2022) focused on the relationship between green bond issuances and carbon footprint in view of environmental performance across economies. According to the authors, green financing improves environmental quality in selected countries. More recently, Tu & Rasoulinezhad (2022) employed quarterly data from 37 countries over the period 2007Q1-2020Q4 to analyze the role of green bond financing on energy efficiency projects and affirmed that green bonds positively influence energy efficiency.

Most researchers assessed the stock market reaction to green bond issuance announcements. Tang & Zhang (2020) carried out one of the pioneering studies. Using comprehensive firm-level data from 28 countries from 2007-2017, they pointed out that stock prices reacted positively to green bond issuances. Similarly, Baulkaran (2019) highlighted that issuing green bond produces positive cumulative abnormal returns except for bonds with higher coupon. Flammer (2021) concentrated on the effect of green bond issuance announcements on firm value using an event study approach. Results proved that

stock market responded positively to such announcements and certified bonds have a stronger impact on stock returns. Zhou & Cui (2019), Flammer (2020) and Dumlu & Keleş (2023) also confirm a positive stock price reaction to the issuance announcement. However, Lebellet et al. (2020) investigated corporate green bond issuances and argued that the market reacts negatively to the announcement. Depending on the different asset pricing models (CAPM, FF3FM and C4FM), authors found cumulative abnormal returns between -0.5 percent and -0.2 percent in corporate stocks, especially on the announcement day and the following day. Using the data of Turkish Banks traded in the stock market, Yağcılar & Yılmaz (2022) document that abnormal returns cannot be directly associated with the green bond issuances.

Finally, few studies evaluate the influence of the global pandemic on the green bond markets. Using the data from the S&P Green Bond Index, Keliuotytė-Staniulėnienė & Daunaravičiūtė (2021) employed correlation and regression analyzes to demonstrate the negative impact of the COVID-19 on the green bond market. In a similar research, Taghizadeh-Hesary et al. (2021) suggested that global green financing activities have reduced due to the COVID-19 outbreak.

Our literature review sheds some light on a large body of the academic literature on green bonds. However, to our best knowledge, there are no studies exploring the interactions among green bond issuances and stock market reactions with particular attention to renewable energy companies. We, therefore, expect that the current paper will fill the gap in the common literature in terms of bond issuance dynamics of renewable energy firms and hence will be guidance to assist institutional investors and regulators.

3. DATA AND METHODOLOGY

In this part of the research, we introduce a large and comprehensive dataset that covers the announcement dates for green bond issuances, which is obtained from Refinitiv, from publicly-traded green energy firms. Considering an estimation window of 100 trading days, we also gather data on firm-level stock price around the announcements from Yahoo Finance and Investing.

Given the use of green bond proceeds and the availability of data, we narrowed down the scope of our study and examined the issuances of energy firms that mainly generate energy from renewable sources (hydro, solar, wind, thermal, biomass etc.). Companies that indirectly engage in green energy production by supplying renewable energy components, constructing energy generation facilities or using a mix of fossil fuel and renewable resources were excluded. Further, we remove firms that have no trading data or are non-publicly traded from the data set. Consequently, our sample contains 185 green bonds from 46 unique issuers and spans 2014 to 2023. Table 1 presents the number of green bond issuances by use of proceeds, and years.

Table 1. Number of Issuances (by use of proceeds and years)

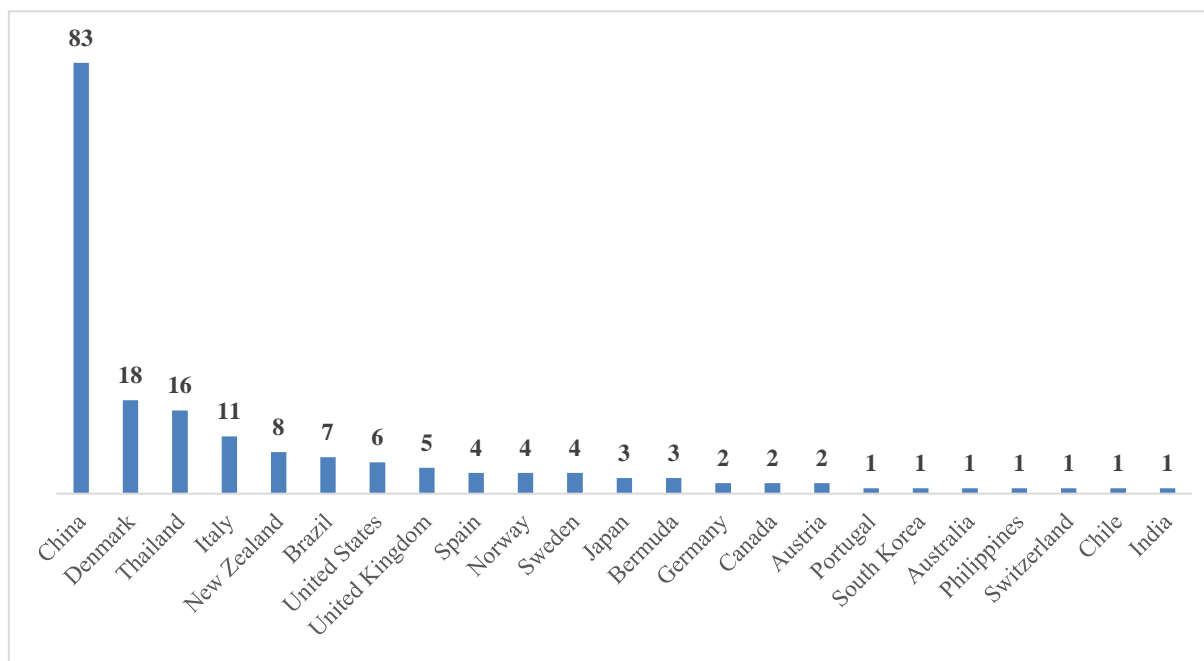
Use of Proceeds	Number	Years	Number
Energy Efficiency	82	2014	3
Renewable Energy Projects	31	2015	1
Climate Change Adaptation	23	2016	5
Eligible Green Projects	18	2017	10
Alternative Energy	11	2018	9
Clean Transport	8	2019	25
General Purpose	4	2020	16
Equipment Upgrade/Construction	2	2021	39
Green Construction/Buildings	2	2022	51
China Urban Construction	1	2023	26
Environmental Protection Projects	1		
Pollution Prevention & Control	1		
Redeem Existing Bonds or Securities	1		
Total	185		185

Source: (Refinitiv Eikon, 2023)

As shown in Table 1, one can argue that the funds raised through green bond issuances are largely used to finance energy efficiency, renewable energy and climate change adaptation projects. In accordance with their purpose, green bonds generally play a significant role in funding environmentally-friendly projects. Green bond issuances have gained momentum particularly after 2019 and 2022 was the year with the highest number of issuance by green energy firms. Figure 1 demonstrates the green bond issuances by country.

According to Figure 1, green energy enterprises operating in China are responsible for about half of total issuances between 2014 and 2023. In our sample, Danish, Thai and Italian firms are the other leading firms in terms of number of issuances, respectively.

Figure 1. Number of Issuances (by country)



Source: (Refinitiv Eikon, 2023)

Table 2 provides some information about the highest value of green bonds.

Table 2. Largest Green Bond Issuances

Issuer	Announcement Date	Issue Date	Maturity	Amount Issued (USD)
Ørsted A/S	6.09.2022	13.09.2022	13.09.2031	975.694.369
Ørsted A/S	16.11.2017	24.11.2017	26.11.2029	813.078.640
Ørsted A/S	7.06.2022	14.06.2022	14.06.2033	813.078.640
SSE PLC	29.08.2023	5.09.2023	5.09.2031	813.078.640
Ørsted A/S	22.02.2023	1.03.2023	1.03.2026	758.873.398
Ørsted A/S	22.02.2023	1.03.2023	1.03.2035	758.873.398
Adani Green Energy Ltd	1.09.2021	8.09.2021	8.09.2024	750.000.000
Adani Green Energy Ltd	1.09.2021	8.09.2021	8.09.2024	750.000.000
Avangrid Inc	14.05.2019	16.05.2019	1.06.2029	750.000.000
Avangrid Inc	7.04.2020	9.04.2020	15.04.2025	750.000.000

Source: (Refinitiv Eikon, 2023)

The Danish company Ørsted A/S issued the green bond with the highest nominal value of \$975 million (Table 2). SSE PLC, Adani Green Energy and Avangrid are the other firms in the top ten in terms of amount issued.

To determine the effects of green bond issuances on the stock market reactions, we use the announcement dates as event time. Table 3 shows the summary statistics of green bonds.

Table 3. Descriptives of Green Bonds

	N	Mean	Median	Max.	Min.	Std. dev
Maturity (year)	185	33,36	5,00	1000,66	0,11	162,82
Coupon (%)	185	3,55	2,88	15,20	0,38	2,30
Amount (mln \$)	185	228,93	126,75	975,69	1,37	229,66

Although our initial sample includes 185 green bonds, we realized that some firms made multiple issuances on the same date, which may lead to erroneous results. Therefore, we dropped the issuances made by the same firms on the same date to overcome such limitations. Or, to put it more clearly, we assumed that there was a single event day or single issuance, hence our final sample includes 156 green bond issuances by 46 renewable energy firms.

We apply the event study methodology Brown & Warner (1985) introduced to test green energy firms' stock market reaction. Event study, which is based on the Efficient Markets Hypothesis by Fama (1970), determines whether the information released on a certain date leads to anomalous stock returns. We utilize a 100-day estimation window starting 110 trading days prior to the announcement and ending 11 trading days prior to announcement (where day 0 is the announcement date). Then, we adopt two different event windows from 10 days prior-10 days after [-10, 10] and from 5 days prior-5 days after [-5, 5] the announcement. In order to perform a robustness check and to investigate stock reactions, we also considered time intervals of [-10, 0], [-5, 0], [0, 5] and [0, 10].

First, we calculated the daily stock returns of firms as follows:

$$R_{i,t} = \ln\left(\frac{P_{i,t}}{P_{i,t-1}}\right) \quad (1)$$

where $R_{i,t}$ represents the return of the firm i on day t , $P_{i,t}$ represents the stock price of the firm i on day t and $P_{i,t-1}$ represents the stock price of the firm i on day $t - 1$. We then use mean – adjusted returns model (MAR) to obtain abnormal daily returns of renewable energy companies as:

$$AR_{i,t} = R_{i,t} - \bar{R} \quad (2)$$

where $AR_{i,t}$ is the abnormal return of firm i , on day t and $R_{i,t}$ is the return of firm i , on day t . \bar{R} denotes the average return of firm over the estimation window (-110, -11) and can be written by

$$\bar{R} = \frac{1}{100} \sum_{t=-110}^{-11} R_{i,t} \quad (3)$$

We used standardized abnormal returns methodology by Brown & Warner (1985) to test the statistical significance of abnormal returns:

$$SAR_{i,t} = \frac{AR_{i,t}}{SD(AR_{i,t})} \quad (4)$$

$$SD(AR_{i,t}) = \sqrt{\frac{1}{T_0-1} \sum_{t=1}^{T_0} AR_{i,t}^2} \quad (5)$$

where $SAR_{i,t}$ shows the standardized abnormal returns and $SD(AR_{i,t})$ shows the standard deviation of abnormal returns.

Afterwards, we compute cumulative abnormal returns (CAR) by summing up the abnormal returns:

$$CAR_{i,t} = \sum_{t=t_1}^{t_2} AR_{i,t} \quad (6)$$

Equation (7) and Equation (8) estimates the t – statistics of average abnormal returns (AAR) and cumulative average abnormal returns (CAAR), respectively (Zhou & Cui, 2019):

$$T - test_{AAR_t} = \frac{AAR_t}{SD(AR_{i,t})/\sqrt{N}} \quad (7)$$

$$T - test_{CAAR_t} = \frac{CAAR_t}{SD(CAR_{i,t})/\sqrt{N}} \quad (8)$$

where $T - test_{AAR_t}$ is the t – statistics for the daily average abnormal returns of all renewable energy firms on day t, $T - test_{CAAR_t}$ is the t – statistics for the cumulative average abnormal returns of all renewable energy firms during the event period. AAR_t is the average abnormal return of all firms on day t, $CAAR_t$ is the cumulative average abnormal return of all firms on day t, while $SD(AR_{i,t})$ and $SD(CAR_{i,t})$ represent the standard deviation of abnormal returns and cumulative abnormal returns, respectively.

4. EMPIRICAL FINDINGS

In the first step, we focused on the stock price reaction to green bond issuance announcements for the final sample, which contains all 156 announcement dates from 46 renewable energy firms, regardless of the use of proceeds or year. We calculate the daily abnormal returns of each firm using mean-adjusted returns model (Eq. 2) and the average abnormal returns (AAR) and cumulative average abnormal returns (CAAR) using the mean values of abnormal and cumulative abnormal returns of firms. In the second and third parts, we shed light on the stock behaviors by use of proceeds and years, respectively.

4.1. Stock Market Response to Green Bond Issuances

Table 4 reports the average abnormal returns (AAR), t-scores, summary statistics and cumulative average abnormal returns (CAAR) across different event windows.

Table 4. Daily AAR's and CAAR's

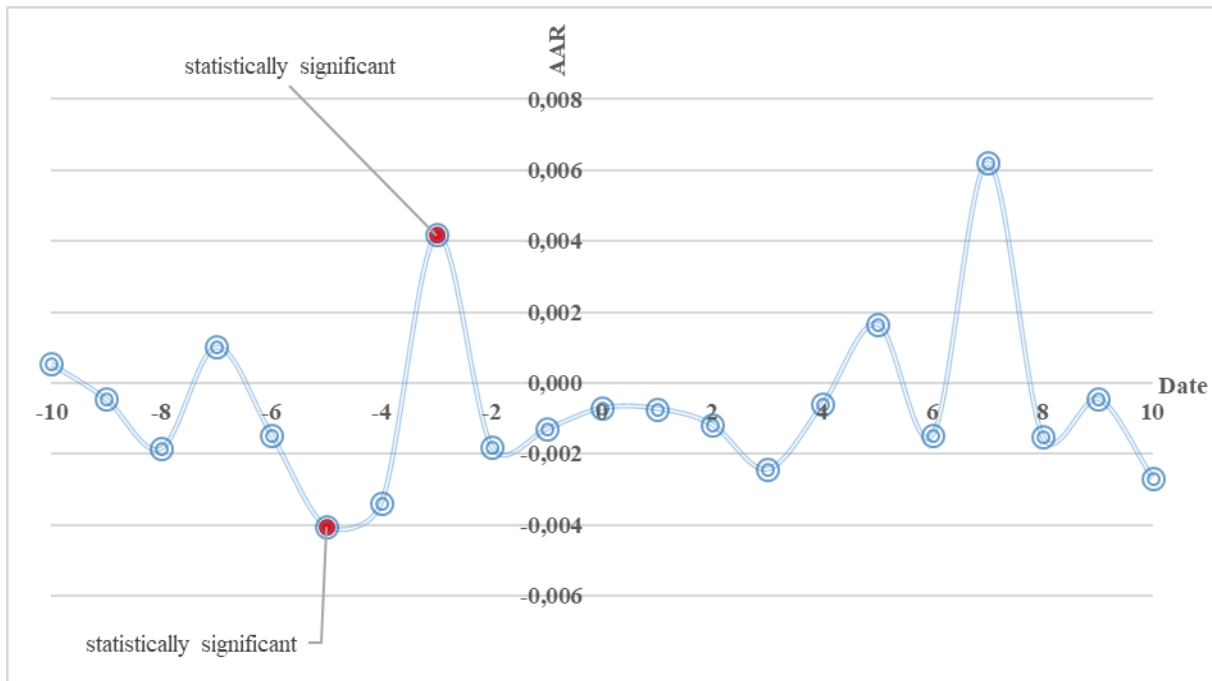
	Date (t)	AAR	T-test	Median	Min	Max
	-10	0.0005	0.2280	-0.14%	-10.34%	15.13%
	-9	-0.0005	-0.1943	0.03%	-19.42%	10.35%
	-8	-0.0019	-1.0573	-0.05%	-12.84%	8.44%
	-7	0.0010	0.5565	-0.18%	-5.72%	16.03%
	-6	-0.0015	-0.8509	-0.22%	-10.21%	6.87%
	-5	-0.0041	-2.3418**	-0.14%	-8.10%	5.47%
	-4	-0.0034	-1.8274	-0.14%	-8.82%	7.98%
	-3	0.0042	2.3015**	0.13%	-3.93%	9.44%
	-2	-0.0018	-0.9937	-0.02%	-5.72%	13.03%
	-1	-0.0013	-0.7052	-0.06%	-6.07%	9.94%
Event Date	0	-0.0007	-0.3592	-0.02%	-7.40%	8.28%
	1	-0.0007	-0.4590	-0.09%	-5.53%	9.97%
	2	-0.0012	-0.5905	-0.09%	-6.51%	14.29%
	3	-0.0024	-1.2668	-0.18%	-7.50%	8.81%
	4	-0.0006	-0.3363	-0.01%	-8.30%	8.14%
	5	0.0017	0.8533	0.02%	-6.14%	15.53%
	6	-0.0015	-0.8998	-0.04%	-7.97%	5.44%
	7	0.0062	1.2722	-0.04%	-7.19%	71.24%
	8	-0.0015	-0.6650	-0.18%	-9.20%	13.54%
	9	-0.0004	-0.1878	-0.02%	-10.39%	13.74%
	10	-0.0027	-1.0481	-0.25%	-14.97%	15.52%
Event Window	[-10, 10]	[-5, 5]	[-10, 0]	[-5, 0]	[0, 5]	[0, 10]
CAAR	-0.01245	-0.01033	-0.00928	-0.00706	-0.00397	-0.00387
SD (CAAR)	0.002364	0.002277	0.002233	0.002908	0.001328	0.002462
t-statistic	-5.2653***	-4.5351***	-4.1555***	-2.4290**	-2.9859***	-1.5729

Note: ***, ** denote statistical significance at the 1% and 5% level, respectively.

According to Table 4, event day average abnormal returns of renewable energy firms are not statistically significant, signifying that there may have been information leakage to the market before the announcements. As a result of this, it would be crucial to examine the average abnormal returns

before and after the green bond issuance announcement. Figure 2 depicts the average abnormal returns in an event window.

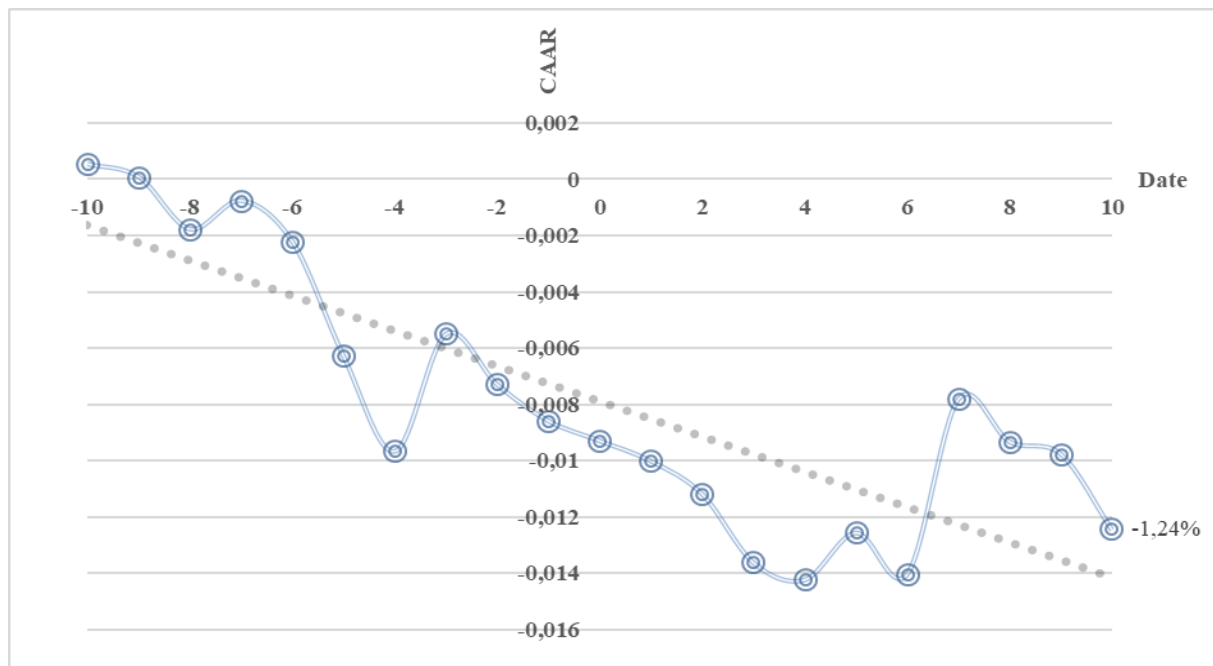
Figure 2. Illustration of Daily AAR's of Green Energy Firms



AAR's are negative on 16 days and positive on 5 days but, in general, there exists no significant return fluctuation before and after the issuance announcement. Interestingly, we observed a statistically significant and positive AAR on the third day prior to the event. Hence one can claim that insider trading through leakage might be playing an important role. Another finding in our analysis suggests that significant negative AAR occurred on the fifth day before the event. In addition, there are no statistically significant AAR coefficients after the event day. Conversely, we detected negative and statistically significant cumulative average abnormal returns (CAAR) in all the event windows except for [0, 10] event windows. These results indicate that green bond issues have a small but negative influence on the shares of green energy companies.

Figure 3 shows green energy companies' cumulative average abnormal returns (CAAR) before and after the event. The average abnormal returns (AAR) changed the sign on the ninth day prior to the event's occurrence and the negative persistence in average abnormal returns continued until the event day. Statistically significant CAAR's point out that green bond issuances have a negative impact on the stock prices of renewable energy firms.

Figure 3. Daily CAAR's of Green Energy Firms over [-10, 10] Event Window



4.2. Stock Market Response to Green Bond Issuances by Use of Proceeds

In this section, we examine the market response to green bond issuance announcements by use of issue proceeds. Table 5 presents the average abnormal returns before and after the event by use of proceeds.

Table 5. Daily AAR's during the event period

Date (t)	AARs by Use of Proceeds							
	General Purpose	Other	Clean Transport	Alternative Energy	Eligible Green Projects	Climate Change Adaptation	Renewable Energy Projects	Energy Efficiency
-10	0.0032	0.0091	0.0088	-0.0048	-0.0041	0.0053	-0.0013	0.0012
-9	-0.0199	0.0032	-0.0040	0.0061	-0.0010	-0.007	0.0017	0.0020
-8	-0.0049***	0.0136	-0.0094***	-0.0083	-0.0016	-0.007	0.0031	-0.0026
-7	-0.0048***	0.0056	-0.0030	0.0044	0.0063	0.0088	0.0017	-0.0028
-6	-0.0189	-0.0159**	0.0011	0.0000	-0.0003	-0.0014	-0.0082	0.00434
-5	0.0053	0.0088	0.0006	-0.0020	0.0026	-0.0057	-0.0115	-0.0051
-4	0.0015	-0.0008	0.0032	-0.0017	-0.0020	-0.0066	-0.0007	-0.0057**
-3	-0.0240***	-0.0047	0.0000	0.0121**	0.0027	-0.0007	0.0080	0.0072**
-2	-0.0009	-0.0084**	-0.0038	-0.0032	-0.0086	-0.0097**	0.0067	-0.0022
-1	-0.0121***	0.0032	-0.0051	-0.0068	-0.0055	0.0047	0.0017	-0.0022
0	-0.0063	-0.0159	-0.0034	0.0093**	-0.0026	-0.0047	0.0060	-0.0009
1	-0.0023	0.0089	-0.0073	0.0032	-0.0078	-0.0017	0.0034	-0.0016
2	-0.0026	0.0108	-0.0090	0.0009	-0.0094	-0.0015	-0.0025	0.0004

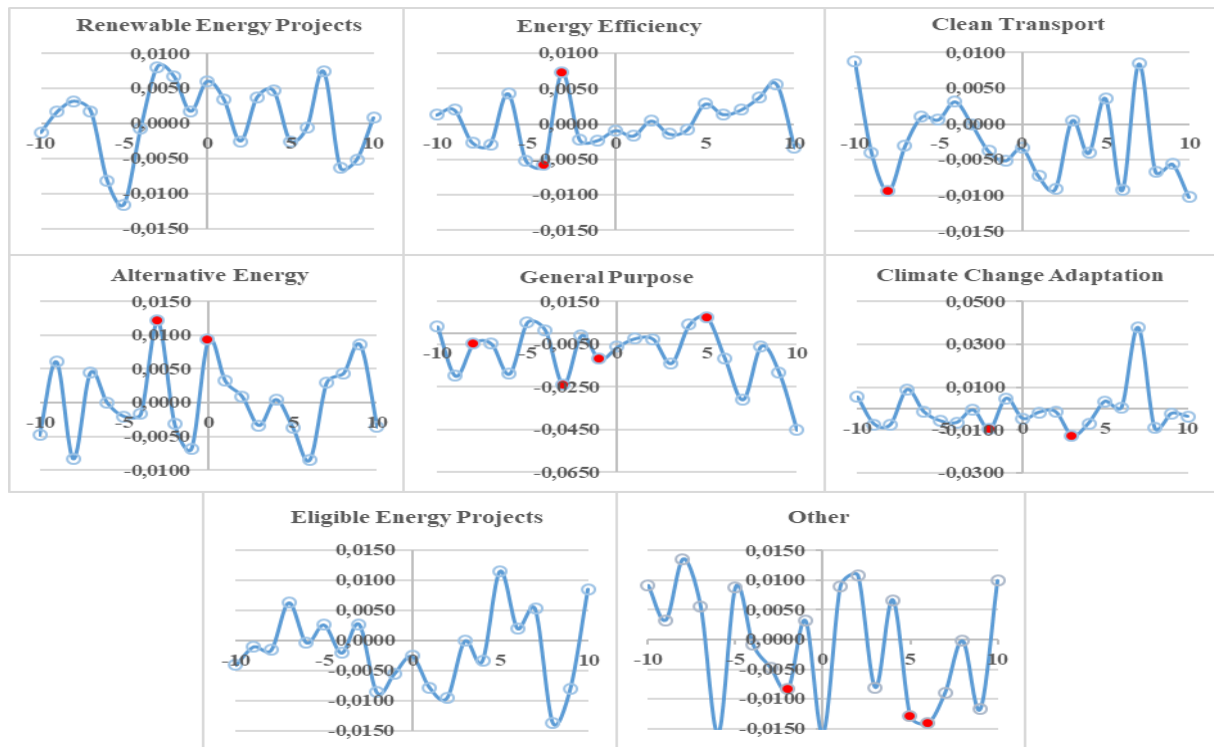
Table 5 (cont.)

Date (t)	AARs by Use of Proceeds							
	General Purpose	Other	Clean Transport	Alternative Energy	Eligible Green Projects	Climate Change Adaptation	Renewable Energy Projects	Energy Efficiency
3	-0.0140	-0.0080	0.0005	-0.0034	-0.0001	-0.0127**	0.0037	-0.0013
4	0.0042	0.0067	-0.0040	0.0005	-0.0034	-0.0068	0.0046	-0.0007
5	0.0075***	-0.0129***	0.0036	-0.0037	0.0115	0.0034	-0.0025	0.0028
6	-0.0119	-0.0142***	-0.0093	-0.0085	0.0020	0.0005	-0.0005	0.0013
7	-0.0310	-0.0089	0.0085	0.0029	0.0053	0.0380	0.0074	0.0020
8	-0.0059	-0.0002	-0.0066	0.0044	-0.0136	-0.0091	-0.0063	0.0037
9	-0.0182	-0.0117	-0.0055	0.0086	-0.0080	-0.0023	-0.0051	0.0056
10	-0.0454	0.0099	-0.0102	-0.0036	0.0086	-0.0037	0.0008	-0.0033

Note: ***, ** denote statistical significance at the 1% and 5% level, respectively.

According to Table 5, we infer that significant AAR's generally appear before the announcement day. As in our initial analysis, we determine a predominantly negative market response to green bond issuances. Only four daily average abnormal returns are positively significant and these belong to “the general purpose”, “alternative energy” and “energy efficiency” categories. Overall, our findings underline that the announcement of green bond issuances leads to negative and significant average abnormal returns in renewable energy firms. Figure 4 demonstrates the stock market reactions due to green bond issuance announcements.

Figure 4. Daily AAR's by use of green bond proceeds



Note: ● denote statistical significance at the 1% or 5% level.

We compute cumulative average abnormal returns across all event windows (Table 6). Results emphasize that cumulative average abnormal returns are positive yet insignificant for [-10, 10] window while all statistically significant cumulative average abnormal returns are negative. We observe statistically significantly negative cumulative average abnormal returns within [-10, 10] and [-5, 5] intervals except for “alternative energy” and “renewable energy projects” categories. Share prices react positively to green bonds issued to finance “renewable energy projects” mainly in the intervals [-5, 5] and [0, 5].

Table 6. CAAR’s by use of proceeds

Event Window	Use of Proceeds							
	General Purpose	Other	Clean Transport	Alternative Energy	Eligible Green Projects	Climate Change Adaptation	Renewable Energy Projects	Energy Efficiency
[-10, 10]	-20.13%	-2.19%	-5.44%	0.65%	-2.88%	-2.11%	1.03%	0.19%
	(-18.96)***	(-2.22)**	(-10.08)***	(1.10)	(-4.77)***	(-1.96)*	(1.91)	(0.56)
[-5, 5]	-4.36%	-1.24%	-2.46%	0.53%	-2.24%	-4.23%	1.70%	-0.97%
	(-4.59)***	(-1.31)	(-5.94)***	(0.92)	(-3.65)***	(-7.96)***	(3.01)***	(-2.69)***
[-10, 0]	-8.18%	-0.22%	-1.51%	0.51%	-1.40%	-2.49%	0.74%	-0.69%
	(-8.18)***	(-0.21)	(-3.12)***	(0.76)	(-3.38)***	(-4.03)***	(1.21)	(-1.73)
[-5, 0]	-3.65%	-1.78%	-0.84%	0.77%	-1.33%	-2.28%	1.03%	-0.91%
	(3.41)***	(-2.04)**	(-2.66)***	(1.01)	(-2.99)***	(-4.46)***	(1.40)	(-1.94)
[0, 5]	-1.34%	-1.04%	-1.95%	0.69%	-1.17%	-2.42%	1.28%	-0.14%
	(-1.76)	(-0.87)	(-4.12)***	(1.44)	(-1.56)	(-4.38)***	(3.43)***	(-0.86)
[0, 10]	-12.58%	-3.56%	-4.27%	1.07%	-1.74%	-0.08%	0.89%	0.80%
	(-8.10)***	(3.35)**	(-7.24)***	(1.95)	(-2.20)**	(-0.06)	(1.93)	(2.98)***

Note: ***, **, * denote statistical significance at the 1%, 5% and 10% level, respectively. t-statistics are in the parentheses.

4.3. Stock Market Response to Green Bond Issuances by Years

Lastly, we offer valuable findings on the relationship between announcements of green bond issuances and stock market reactions over the years. Since the number of green bonds issued increased dramatically in the last few years, we combine green bond issuances until 2020. We calculate cumulative average abnormal returns for each year from 2020 to 2023 (Table 7).

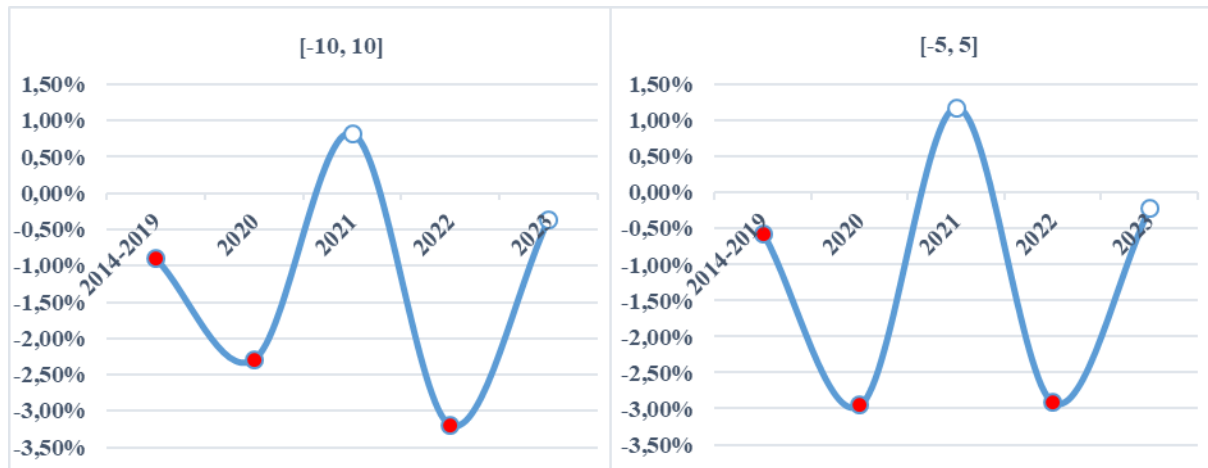
Table 7. CAAR’s by years

Event Window	Years				
	2014 – 2019	2020	2021	2022	2023
[-10, 10]	-0.90%	-2.30%	0.83%	-3.20%	-0.36%
	(-2.70)***	(-3.34)***	(1.31)	(-8.26)***	(-1.06)
[-5, 5]	-0.57%	-2.95%	1.18%	-2.91%	-0.21%
	(-2.43)**	(-3.66)***	(1.70)	(-13.35)***	(-0.70)
[-10, 0]	0.29%	-3.18%	-0.80%	-1.99%	-0.03%
	(0.88)	(-4.84)***	(-1.08)	(-7.56)***	(-0.07)
[-5, 0]	-0.27%	-3.28%	0.07%	-1.34%	0.10%
	(-0.92)	(-4.44)***	(0.07)	(-5.44)***	(0.27)
[0, 5]	-0.34%	-0.59%	2.05%	-2.09%	-0.49%
	(2.18)**	(-0.69)	(4.18)	(-10.91)	(-2.37)
[0, 10]	-1.23%	-0.02%	2.57%	-1.73%	-0.50%
	(-3.84)***	(-0.03)	(4.97)***	(-3.50)***	(-1.83)

Note: ***, ** denote statistical significance at the 1% and 5% level, respectively. t-statistics are in the parentheses.

Table 7 indicates a significant negative investor reaction to green bond issuances until 2020. In the same vein, stock responses remain negative both in 2020 and 2022 but we detect a positive and insignificant reaction in 2021. Figure 5 presents cumulative average abnormal returns in the $[-10, 10]$ and $[-5, 5]$ intervals.

Figure 5. Illustration of CAAR's by years



Note: ● denote statistical significance at the 1% or 5% level.

In Figure 5, we observe similar CAAR patterns over main time intervals. A possible reason for positive reaction in 2021 may be that the expansive monetary and fiscal policies worldwide during the Covid-19 pandemic. In the following years, many countries have taken steps, especially increasing interest rates, to slow soaring inflation and this has led to negative extremes in financial markets.

5. CONCLUDING REMARKS

As a result of the rising worldwide environmental awareness, practices such as renewable energy generation, waste management, and clean transportation have come to the fore in order to ensure sustainability and achieve sustainable development goals. Fighting climate change, however, requires considerable amounts of financial resources. Green bonds have emerged as alternative financial instruments to fund environmentally-friendly projects and to accelerate the transition to a low-carbon economy. Green bonds are of great importance not only for regulatory bodies and policy makers, but also for investors and issuers, as stakeholders take into account the environmental performance of firms as well as their financial performance (Reboredo et al., 2020). Following the first issuance of a green bond by the European Investment Bank in 2007, the green bond market has seen rapid growth (Gianfrate & Peri, 2019).

In addition to the environmental impacts and sustainability profiles of projects, their social impacts are also considered by institutional investors in portfolio management decisions. Therefore, examining green bonds which focus on environmental sustainability is warranted (Baulkaran, 2019). In light of this, we attempted to explore the response of the share prices to the announcements of green bond issuances. No study so far, as per our knowledge, has investigated the impact of green bond

issuance announcements on stock returns with the focus on renewable energy firms. Using the event study methodology, we analyze 185 green bonds by 46 unique public issuers from 2014 to 2023. Our results indicate that green bond issuance announcements generate statistically significant negative (except for [0, 10] event window) impacts on stock returns. This finding is consistent with the study by Lebellet et al. (2020). Since renewable energy firms invest in green projects due to the nature of their activities, one can claim that bond issuance may burden a firm more. Another possible reason may be that it is unclear whether new investments will positively influence financial performance and profitability. We next concentrate on the issuance announcements according to the use of the proceeds and find out that share price reaction does not depend on the use of the proceeds and remains negative. This implies that investors do not pay much attention to what kind of projects will be financed. Further, significant negative AAR's generally appear in the days prior to the announcement, which can be a symptom of insider trading. Finally, we investigate the announcements by years to document a statistically significantly negative stock market response in both 2020 and 2022, unlike positive but insignificant reactions in 2021. We argue that Covid-19 pandemic which started in 2020 and the rising global interest rates in 2022 to control inflation led to a bad atmosphere in financial markets and affected investor reactions. Our results suggest that share prices react negatively to green bond issuance announcements.

Private sector participation, the prominent role of capital markets, and financial regulatory policies are critical for financing green investments (Baker et al., 2022). States, international agencies and the private sector should take appropriate steps to support the growth of green bond markets, improve liquidity and increase the visibility of green bonds. Raising awareness of green bonds may influence investors' reactions to issuing these financial products. Moreover, post-issuance reporting will contribute to reducing information asymmetry. On the other hand, firms can expand their investor base by attracting environmentally conscious investors, thanks to green bonds.

Against this background, this study suffers from a major limitation but also calls for future research. Our data set only contains 156 green bond issuances from 46 firms that generate energy from renewable sources. Generalizing our results, therefore, may lead to incorrect judgments. In this vein, it would be fruitful to expand the data set by including firms in different sectors to make inter-sectoral comparisons. Another pathway could be to use different event window lengths. Future research might also assess the portfolio diversification benefits of green bonds by addressing correlations between green bonds and other assets—and a fortiori green stocks—and spillover behaviors. At last, investigating the factors that affect the issuance of green bonds would be another promising research avenue.

The study does not necessitate Ethics Committee permission.

The study has been crafted in adherence to the principles of research and publication ethics.

The authors declare that there exists no financial conflict of interest involving any institution, organization, or individual(s) associated with the article. Furthermore, there are no conflicts of interest among the authors themselves.

The authors contributed equally to the entire process of the research.

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A Hybrid Multidimensional Performance Measurement Model Using the MSD-MPSI-RAWEC Model for Turkish Banks *

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Abstract

The purpose of the paper is to analyze the multidimensional sustainability performance of deposit banks that operate in the Turkish banking industry. For this aim, the current research presents a novel hybrid decision-making model comprising of MSD, MPSI and RAWEC methodologies. In the developed decision-making model, the MSD and the MPSI objective weighting methods are utilized to assign significance weights to the criteria, while the RAWEC, a relatively new technique, is employed for banks' ranking. In order to check the robustness of the recommended model, various sensitivity and benchmark analyses were conducted. According to the findings of the study, the most important criterion in determining the sustainability performance of deposit banks is the total hours spent on employee training. Moreover, the most successful bank in terms of multidimensional sustainability is Garanti BBVA. Furthermore, sensitivity and comparison analyses prove that the integrated framework in this study is a powerful, reliable and useful decision tool that can be utilized in assessing the sustainability performance of banks. Besides, practical and managerial implications based on the findings of the applied decision-making tool are discussed.

Keywords: Banks, Sustainability Performance, MSD, MPSI, RAWEC.

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1. INTRODUCTION

Banks play a critical role as financial intermediaries not only in developed economic systems but also in developing economic systems. They are responsible for almost all transactions in money and capital markets, regardless of whether the financial system is market-oriented or bank-oriented (Shabir et al., 2021; Zahid et al., 2021, Işık et al., 2024). Driven by the desire to make profit, banks play an essential role in fulfilling the financing needs of the real sector by channeling the savings in the financial system to investments (Işık, 2017; Bucevska and Hadzi Misheva, 2017). The banking sector is vital for the economic and sustainable development of countries (Love and Rachinsk, 2015; Işık and Belke, 2017; Zhou et al., 2021). Its role extends beyond providing financial stability to the economy. A strong macro-level infrastructure and a healthy banking sector are crucial for sustainable prosperity, particularly in times of systematic and unsystematic risks, such as credit risk (Wu and Shen, 2013). It is, therefore, crucial to continuously analyze the performance of banks to ensure they can emerge from any crisis with minimal impact. Any necessary regulations and improvements should be implemented to establish a solid foundation for banking operations based on empirical findings (Amile et al., 2013; Munteanu, 2012).

Performance assessment is a highly important topic for internal and external stakeholders in the banking industry. The primary aim of performance measurements is to identify the effective use of available resources. Given the prior works in the literature aimed at gauging the performance of the banking sector, it is seen that most of these studies were carried out solely depending on financial indicators. However, this situation causes banks to be assessed from a single dimension, or in other words, only from a financial perspective (McGuire et al., 1988; Ullmann, 1985). In today's global financial markets, evaluating bank performance in a single dimension can be misleading. Because, besides financial factors, there are also environmental factors that influence bank performance (Ren et al. 2023). Data on environmental, social and governance issues obtained from sustainability reports published by banks enable the evaluation of the performance of banks not only in financial terms but also based on non-financial ESG indicators (Ielasi et al., 2023; Meng-tao et al., 2023; Shabir et al., 2024a; Işık, 2023). This evaluation process goes beyond financial performance and enables a more holistic perspective on performance (Gaur et al., 2011). Besides, as one of the most efficient institutions in the financial intermediation process, any deterioration in the performance of banks can have significant economic consequences for companies, individuals, and governments. It is therefore crucial to systematically analyse the sustainability of banks' performance in order to promote sustainable economic development (Shabir et al., 2024b). Moreover, the COVID-19 pandemic and the recent political and financial crises have revealed the need to regularly measure and evaluate banks' multi-dimensional performance (Xiazi and Shabir, 2022; Shabir et al., 2023).

The present research aims to examine the banks' sustainability performance according to a novel set of criteria covering four main dimensions, such as financial, environmental, social, and corporate

governance. To that end, a novel combined decision-making framework is presented in the existing work, which includes Modified Standard Deviation Method (MSD), Modified Preference Selection Index (MPSI) and Ranking of Alternatives by Criterion Weights (RAWEC) techniques. Overall, with the aid of the presented hybrid framework, the present research aims to respond to the given research questions below.

RQ1. Why is it important to compare the performance of banks in terms of multidimensional performance?

RQ2. Which criteria should be considered for multidimensional performance assessment in the banking industry?

RQ3. What is the most significant variable affecting multidimensional performance in the banking industry?

RQ4. Which bank in the Turkish commercial banking industry is more successful than its competitors in terms of multidimensional performance?

With the aid of research questions that address gaps in the prior literature, bank executives and other decision makers in the banking industry can identify a practical and trustworthy methodological approach to analyzing in detail the multidimensional sustainability performance of banks. The novelty and contributions of the recommended decision-making tool can be summarized as follows:

- The existing work presents a methodological framework and decision support system for addressing multidimensional performance measurement problems for decision makers in the field of banking.
- The outcomes obtained from the procedures using MSD and MPSI are integrated via an aggregation operator to compute the optimal weights of the criteria. The weighting strategy pursued in existing work is utilized for the first time in the MCDM literature.
- The RAWEC algorithm, which is a relatively novel ranking procedure, is implemented for the first time in the MCDM literature.
- To investigate banks' multidimensional performance, a case study has been carried out that considers 21 performance metrics derived from a combination of the CAMELS rating system and ESG practices. The current work is also the first to examine the multidimensional performance of banks through an integrated decision framework.
- Managerial implications for industry-linked decision-makers are provided to improve the multidimensional performance of the banking industry and build a sustainable banking system.
- In order to test the validity of the suggested decision-making model, a thorough sensitivity and benchmarking study has been carried out.

The following sections are organized as follows: Section two provides a comprehensive literature review and explains how the study will fill gaps in the literature. The paper discusses the suggested MCDM tools from a theoretical perspective in the third section. The case study is presented in section four, followed by the outcomes of the suggested framework for multidimensional performance assessment for banks in section five. Section six presents sensitivity analyzes and related validation analyses, while section seven discusses practical and managerial implications. The final section summarizes the achieved outcomes and provides recommendations for future work.

2. RESEARCH BACKGROUND

This section is divided into two subsections. In the first subsection, background information is given by summarizing banking studies using MCDM models. In the second subsection, research gaps that form the basis for the purpose and motivation of the current study are presented.

2.1. MCDM Studies in the Banking Industry

Since banks are an indispensable part of a sustainable economic system, the number of studies gauging bank performance from different aspects employing MCDM approaches continues to increase rapidly. A brief summary of some studies in the existing literature is presented below to provide background information.

Havrylchuk (2006) used the DEA method to analyze the efficiency of the Polish banking system from 1997 to 2001. The study found that foreign-capitalized banks were more successful than nationally capitalized banks. Seçme et al. (2009) evaluated the performance of five banks in Turkey using the Fuzzy AHP and TOPSIS methods. The analysis revealed that Ziraat Bank had the best performance in 2007, while Yapı Kredi Bank had the worst performance. Gishkori and Ullah (2013) evaluated the efficiency levels of banks in Pakistan with various ownership structures using DEA and Tobit Regression methods from 2007 to 2011. The study performed that 5 banks achieved the targeted efficiency levels in 2007, 8 banks in 2008, 20 banks in 2009, 27 banks in 2010, and 23 banks in 2011. Moreover, based on Tobit regression analysis, bank-level indicators are crucial in determining technical efficiency levels. In a separate study, Doğan (2013) compared the performance of 10 banks listed on the BIST using the Gray Relational Analysis method. The analysis, which covered the period from 2005 to 2011, concluded that Akbank had the most successful performance during that time. Mandić et al. (2014) assessed the performance of commercial banks in Serbia employing Fuzzy AHP and TOPSIS methods. The assessments for the period 2005-2010 showed that Banca Intesa was the most successful bank, while Moskovska Bank was the least successful. Yamaltdinova (2017) analyzed the performance of 15 Kyrgyz deposit banks for the period 2010-2014 employing expert opinion and TOPSIS methods. The methods used showed that Demir Kyrgyz International Bank performed the best during the relevant periods. In a separate study of 8 banks listed on the Malaysian Stock Exchange from 2011-2015, Siew et al. (2017) utilized the equal weight and TOPSIS model and found that CIMB Group Holdings Berhad

was the most successful bank during the analyzed periods. Wanke et al. (2018) analyzed the performance of banks operating in BRICS countries employing Fuzzy TOPSIS and Bootstrap Regression models. The study, conducted for the 2010-2014 period, revealed a positive relationship between the efficiency level of the banking system and the savings and GINI index in the country. Laha and Biswas (2019) suggested the Entropy and CODAS integrated model in their study, using a sample of 5 public and 5 private banks in India for the period 2012-2016. The study found that privately owned banks outperformed publicly owned banks. Işık (2020) analyzed the performance of three state-owned development and investment banks in Turkey from 2014 to 2018 employing a hybrid tool consisting of SD, MABAC and WASPAS methods. The author's outcomes demonstrate that Turk Eximbank was the most successful during this period. Sama et al. (2020) evaluated the performance of 18 private sector banks in India from 2018 to 2019 using CRITIC-TOPSIS and CRITIC-GIA methods. After applying the selected analysis methods, HDFC Bank ranked first, and Bandhan Bank ranked second. The rankings of other banks were found to vary. Furthermore, Gazel et al. (2021) examined the performance of deposit banks in Turkey utilizing an integrated model consisting of Fuzzy Entropy, Fuzzy TOPSIS and Regression methods to determine the criteria. Adabank, Deutsche Bank and Citibank were the top-performing banks from 2007-2017. In 2020, Rao et al. analyzed the performance of six privately owned Indian banks with the help of SD, CRITIC, ARAS and MOORA methods. The analysis revealed that HDFC had the highest performance, while Yes Bank had the lowest. The study used MEREC, PSI, and MAIRCA methods. Işık (2022) conducted a study on the performance of the Turkish participation banking sector from 2019Q1 to 2020Q4. It was reported that the sector's most successful period was December 2020, while the least successful period was March 2019. Milenković et al. (2022) ranked banks in the Western Balkan states according to their efficiency levels using the fuzzy DEA method in a sample of banks. The study conducted between 2015 and 2019 found that efficiency levels varied both between and within countries over the years. Avşarlıgil et al. (2023) employed Entropy, ARAS, MOORA and MOOSRA methods to evaluate the performance of 13 commercial banks in Turkey for the period 2019-2020. The study concluded that Ziraat Bank was the most successful bank, while Halkbank consistently ranked among the top 5 most successful banks. Kumar and Sharma (2023) evaluated the performance of ten large commercial banks in India from 2016-2017 to 2020-2021 via AHP and TOPSIS techniques. They found that return on equity had the highest impact on bank performance. Bandhan Bank was ranked as the best performing bank. The performance of 39 commercial banks operating in China between 2010 and 2018 was evaluated using DEA and SSRP algorithms. Productivity levels were found to gradually increase between 2010 and 2015, while fluctuating in other periods. Ali et al. (2024) analyzed the performance of 19 Iraqi banks between 2007 and 2020 using an integrated MCDM framework that consists of CRITIC and RAFSI techniques. The study measured financial sustainability performance and identified BTRI as the most successful bank and BNOR as the least successful. Kumar and Sharma (2024) evaluated the performance of the nine largest private sector banks in India with the aid of CRITIC and TOPSIS approaches. The analyses

performed for the periods 2015-2016 and 2020-2021 determined that Bandhan Bank was the most successful bank throughout all periods.

2.2. Research Gap Analysis

The review of the previous literature shows that there are a large number of studies analyzing the performance of the banking sectors of different countries. However, most of these works are focused on financial performance analyses. Given today's competitive conditions, assessing bank overall performance only from a financial perspective may lead to a one-sided and non-objective assessment. To fill this gap in the literature, the current work introduces a set of criteria for analyzing multidimensional bank sustainability performance that includes both financial and non-financial performance indicators.

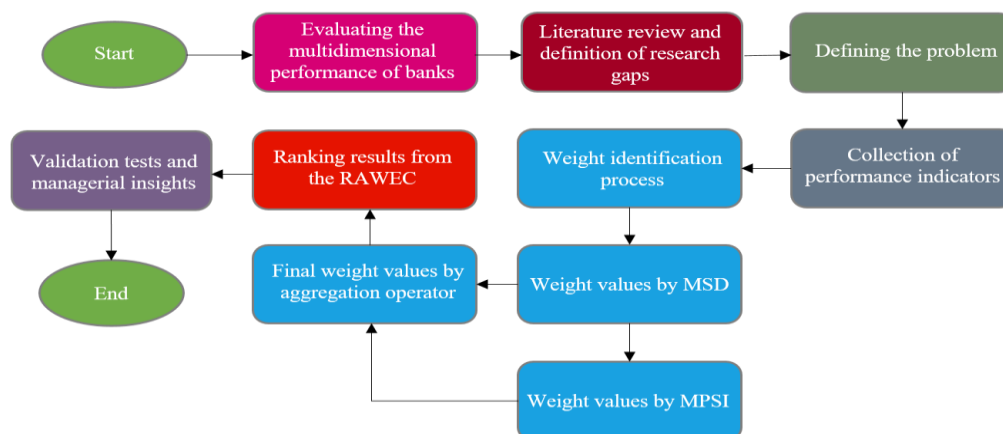
The second gap pertains to the lack of research in the literature that combines the MSD, the MPSI, and the RAWEC approach to gauge banks' sustainability performance. Thus, suggesting a performance measurement framework that integrates the beneficial aspects of the three approaches aims to fill the second research gap by providing a more holistic and practical evaluation of banks. Hence, the introduced decision-making tool has the potential to fulfill the need for a decision support system or methodological framework to accurately analyze the strengths and weaknesses of individual banks in comparison to others operating in the same industry.

The MSD-MPSI-RAWEC methodology formulated in this article assess and rank alternative banks and can help monitor and improve the multidimensional performance of banks in a competitive business environment.

3. METHODOLOGY

This section describes the recommended decision framework, i.e., the MSD-MPSI-RAWEC framework, for solving the multidimensional performance decision-making problem about the banking industry, as illustrated in Figure 1.

Figure 1. Proposed Approach



Note: Created by the author.

3.1. Modified Standard Deviation (MSD) Procedure

The MSD procedure developed by Puška et al. (2022) is an extension of the standard deviation (SD) technique. Unlike the SD approach, it includes two extra steps. The first step is to compute the sum of the column. The second step is to correct the value of the standard deviation based on this indicator. This procedure includes the following steps:

Step 1. The decision matrix (Y) is prepared as in Eq. (1). This matrix includes m alternatives, K_1, \dots, K_m based on the n criteria, D_1, \dots, D_n .

$$Y = [y_{ij}]_{m \times n} \quad (1)$$

where y_{ij} indicates the assessment of the i-th alternative and the j-th criterion.

Step 2. This matrix is normalized based on Eq. (2) (for beneficial attributes) and Eq. (3) (for non-beneficial attributes).

$$v_{ij} = \frac{y_{ij}}{\max\{y_{ij} | i = 1, 2, \dots, m\}} \quad (2)$$

$$v_{ij} = \frac{\min\{y_{ij} | i = 1, 2, \dots, m\}}{y_{ij}} \quad (3)$$

Step 3. Calculating the standard deviation of each criterion (σ_n).

Step 4. Computing the sum of the sum of the columns.

Step 5. The corrected value of the standard deviation is calculated with the help of Eq. (4).

$$\sigma' = \frac{\sigma}{\sum_j^n y_{ij}} \quad (4)$$

Step 6. The final weights of the criteria are determined by applying Eq. (5).

$$w_j^{(MSD)} = \frac{\sigma'_j}{\sum_{j=1}^n \sigma'_j} \quad (5)$$

3.2. Modified PSI (MPSI) Procedure

The MPSI approach is a modified version of the Preference Selection Index (PSI) technique by developed by Maniya and Bhatt (2010). It is a flexible and easily applicable tool to address various MCDM issues (Gligorić et al., 2022). The method defines objective weights of the criteria and is characterized by its simplicity and understandability. The newly developed approach is effective in calculating weight coefficients and saves time in the process. For this reason, it is accepted and used as an effective method in weighting the criteria included in the decision process. This method consists of five sequential steps summarized below:

Step 1. A decision matrix (Y) is built. This matrix was demonstrated in Eq. (1).

Step 2. The normalized decision matrix is constructed as shown in Eq. (2) (for beneficial attributes) and Eq. (3) (for non-beneficial attributes).

Step 3. The mean values of the normalized decision matrix are found via Eq. (6):

$$\psi_j = \frac{1}{m} \sum_{i=1}^m v_{ij} \quad (6)$$

Step 4. Calculate the preference variation value ϑ_j as follows:

$$\vartheta_j = \sum_{i=1}^m (v_{ij} - \psi_j)^2 \quad (7)$$

Step 5. The weights of criteria are found with the help of following equation:

$$w_j^{(MPSI)} = \frac{\vartheta_j}{\sum_{j=1}^n \vartheta_j} \quad (8)$$

3.3. Combined Weights

The utilization of a variety of MCDM approaches in the estimation of criterion weight values leads to some differences in weight values. In order to overcome this problem, an aggregation operator is applied in this paper to compute the criterion weights efficiently while taking into account the influence of different MCDM methods at the same time (Işık et al., 2023). In the present manuscript, the criteria weights of MSD and MPSI are denoted as $w_j^{(MSD)}$ and $w_j^{(MPSI)}$, respectively, and the final weight of each criterion is computed from Eq. (9).

$$w_j = \psi w_j^{(MSD)} + (1 - \psi) w_j^{(MPSI)} \quad (9)$$

3.4. RAWEC Method

The RAWEC method, one of the alternative ranking techniques in the field of MCDM, was recently introduced by Puška et al. (2024). Compared to many other MCDM approaches, this tool is simple, easy to implement, and effective. The procedure is based on double normalization and the calculation of deviations from ideal and anti-ideal values. This algorithm executes the following steps.

Step 1. A decision matrix (Y) is built. This matrix was demonstrated in Eq. (1).

Step 2. The normalized decision matrix is constructed by applying Eq. (10) (for beneficial attributes) and Eq. (11) (for non-beneficial attributes). Here, Double normalization, as shown in Eq. (11) and (12), is employed to normalize the decision matrix.

$$v_{ij} = \frac{y_{ij}}{\max\{y_{ij} | i = 1, 2, \dots, m\}} \text{ and } v'_{ij} = \frac{\min\{y_{ij} | i = 1, 2, \dots, m\}}{y_{ij}} \quad (10)$$

$$v_{ij} = \frac{\min\{y_{ij} | i = 1, 2, \dots, m\}}{y_{ij}} \text{ and } v'_{ij} = \frac{y_{ij}}{\max\{y_{ij} | i = 1, 2, \dots, m\}} \quad (11)$$

Step 3. Eq. (12) and (13) are applied to obtain the deviation from the criterion weight.

$$n_{ij} = \sum_{i=1}^m w_j \cdot (1 - v_{ij}) \quad (12)$$

$$n'_{ij} = \sum_{i=1}^m w_j \cdot (1 - v'_{ij}) \quad (13)$$

Here w_j indicates the final weight of criteria.

Step 4. The values of Ω_i are found for each alternative through Eq. (14).

$$\Omega_i = \frac{n'_{ij} - n_{ij}}{n'_{ij} + n_{ij}} \quad (14)$$

Based on the RAWEC procedure Ω_i takes values between -1 and 1. Here, the alternative with the highest Ω_i values are considered to be the best alternative.

4. A REAL CASE APPLICATION OF PERFORMANCE EVALUATION FOR BANKS

Multidimensional performance measurement in banking sectors is an intricate process that requires flexible and mathematical techniques due to the fact that it depends on many conflicting criteria. Furthermore, owing to the vital role that bankers play in creating a sustainable financial system via their financial services and investments, analyzing sustainability performance in the banking sector is quite critical. Therefore, this work aims to address the issue of sustainability performance measurement in the banking sector via a novel sustainability performance measurement model. In accordance with this purpose, a real-time case study is performed on Turkey's 6 leading commercial banks. The names of the alternative banks considered in this study and their market shares are shown in Table 1. Additionally, the key performance indicators considered as evaluation criteria are given in Table 2

Table 1. The Decision Alternatives

Code	Alternative	Market share (%)
A1	Akbank T.A.Ş.	0.0820
A2	Türkiye Garanti Bankası A.Ş.	0.0879
A3	Türkiye Halk Bankası A.Ş.	0.1061
A4	Şekerbank T.A.Ş.	0.0048
A5	Türkiye Vakıflar Bankası T.A.O.	0.1282
A6	Yapı ve Kredi Bankası A.Ş.	0.0845

Table 2. The Key Performance Indicators

Code	Definition	References
C1	Total Equity/Risk-Weighted Assets	Mili et al. (2017), Aras and Kazak (2022), Yıldırım and Yaman (2023)
C2	Total Loans / Total Assets	Zakaria and Purhanudin (2017), Zarafat and Prabhune (2018), Prabowo et al. (2018), Rawan (2019)
C3	Net Operating Income/Total Assets	Hayajneh and Yassine (2011), Khalaf et al. (2015), Cui et al. (2023), Feng and Wu (2023)
C4	Net Profit/ Total Assets	Mili et al. (2017), Buallay et al. (2021), Ali et al. (2023)
C5	Liquid Assets / Short-Term Foreign Liabilities	Wang et al. (2020), Coetzee and Genukile (2020), Chatzitheodorou et al. (2021), Brei et al. (2024)

Table 2 (Cont.)

Code	Definition	References
C6	Non-Interest Income / Total Assets	Zakaria and Purhanudin (2017), Işık (2019), Karadayı (2023), Mehzabin et al. (2023)
C7	Greenhouse Gas Intensity Per Asset	Khan (2011), Sobhani et al. (2012), Korga and Aslanoğlu (2022), Kim et al. (2023), Greer et al. (2024)
C8	Energy Intensity Per Asset	Korga and Aslanoğlu (2022), Atif et al. (2022), Kumar et al. (2023), Wei et al. (2023)
C9	Water Intensity Per Assets	Korga and Aslanoğlu (2022), Huang et al. (2023), Liu et al. (2023)
C10	Water Intensity Per Employee	Özçelik and Avcı Öztürk (2014), Ruberti, (2023)
C11	Paper Consumption Per Employee	Özçelik and Avcı Öztürk (2014), Aydın et al. (2023)
C12	Number Of Branch	Rebai et al. (2016), Staupoulou and Sardianou (2019), Yıldırım and Yaman (2023)
C13	Number Of ATM	Rebai et al. (2016), Staupoulou and Sardianou (2019), Yıldırım and Yaman (2023)
C14	Number Of Employees	Khan (2011), Staupoulou and Sardianou (2019), Yıldırım and Yaman (2023)
C15	Employee Turnover Rate	Khan (2011), Özçelik and Avcı Öztürk (2014), Ielasi et al. (2023)
C16	Total Hours Spent by Firm-Employee Training	Khan (2011), Özçelik and Avcı Öztürk (2014), Korga and Aslanoğlu (2022)
C17	Audit Committee Meetings	Umar et al. (2023), Gbenyi et al. (2023), Wulandari and Barokah(2023), Chronopoulos et al. (2023)
C18	Board Size	De Andres et al. (2005), Laksmana, (2008), Gurol and Lagasio (2022), Wu et al. (2023)
C19	Percentage Of Non-Executive Directors on Board	Oyekale et al. (2022), Muhammad et al. (2023), Oppong and Lartey, (2023), Amin and Cuming, (2023)
C20	Number Of Executives / Company Managers	Kumara and Walakumbura (2023), Khandelwal et al. (2023), Le et al. (2023), Cao et al. (2024)
C21	Board Duration (Years)	Singareddy et al. (2018), Hassan et al. (2023), Tan and Valdez, (2023)

5. IMPLEMENTATION OF THE MSD-MPSI-RAWEC MODEL

In this section of the existing work, the application outcomes of the decision framework for gauging the sustainability performance of banks are presented.

5.1. The Results of MSD Procedure

The decision matrix which includes alternative banks and evaluation criteria is illustrated in Table 3.

Table 3. Initial Decision Matrix

	A1	A2	A3	A4	A5	A6
C1	14.29	13.25	6.45	7.42	6.36	11.39
C2	52.12	58.10	60.53	56.56	56.73	54.55
C3	7.09	6.10	1.45	2.91	2.22	5.88
C4	52.30	50.53	22.13	39.11	30.22	55.60
C5	28.88	32.51	17.50	32.37	30.13	27.24
C6	2.71	3.23	0.47	1.84	1.52	2.41
C7	0.05	0.05	0.03	0.13	0.02	0.04
C8	0.13	0.12	0.09	0.36	0.07	0.11

Table 3 (Cont.)

	A1	A2	A3	A4	A5	A6
C9	0.04	0.18	0.15	0.60	0.11	0.19
C10	3.71	12.56	10.63	12.06	11.20	14.60
C11	0.03	0.04	0.11	0.17	0.06	0.12
C12	711	837	1038	238	949	801
C13	5553	5450	4075	280	4148	4715
C14	12717	20781	20781	3427	16961	15431
C15	7.21	3	1.7	23.3	2.89	11.9
C16	419661	948237	34704.27	79437.9	41724.06	799097
C17	4	7	4	5	21	4
C18	10	11	9	11	9	12
C19	70.00	90.91	88.89	63.64	88.89	83.33
C20	15	11	14	11	12	17
C21	1	3	3	3	3	1

The elements of the decision matrix shown in Table 3 are normalized via Eq. (2) and (3). Table 4 shows normalized decision matrix.

Table 4. Normalized Decision Matrix

	A1	A2	A3	A4	A5	A6
C1	1.00	0.93	0.45	0.52	0.45	0.80
C2	0.86	0.96	1.00	0.93	0.94	0.90
C3	1.00	0.86	0.20	0.41	0.31	0.83
C4	0.94	0.91	0.40	0.70	0.54	1.00
C5	0.89	1.00	0.54	1.00	0.93	0.84
C6	0.84	1.00	0.15	0.57	0.47	0.75
C7	0.46	0.50	0.74	0.18	1.00	0.57
C8	0.51	0.53	0.71	0.18	1.00	0.60
C9	1.00	0.23	0.27	0.07	0.37	0.22
C10	1.00	0.30	0.35	0.31	0.33	0.25
C11	1.00	0.76	0.27	0.18	0.47	0.25
C12	0.68	0.81	1.00	0.23	0.91	0.77
C13	1.00	0.98	0.73	0.05	0.75	0.85
C14	0.61	1.00	1.00	0.16	0.82	0.74
C15	0.24	0.57	1.00	0.07	0.59	0.14
C16	0.44	1.00	0.04	0.08	0.04	0.84
C17	0.19	0.33	0.19	0.24	1.00	0.19
C18	0.83	0.92	0.75	0.92	0.75	1.00
C19	0.77	1.00	0.98	0.70	0.98	0.92
C20	0.88	0.65	0.82	0.65	0.71	1.00
C21	0.33	1.00	1.00	1.00	1.00	0.33

In Table 5, firstly, the standard deviation of each normalized criterion is calculated. Secondly, the sum of these criteria is found. Next, with the help of Eq. (4), the corrected value of the standard deviation for each criterion is calculated. As seen in the last row of Table 5, the weight value of each criterion is obtained by utilizing Eq. (5).

Table 5. The Results of MSD Procedure

	σ	Σ	σ/Σ	$w_j^{(MSD)}$
C1	0.25	4.14	0.06	0.04
C2	0.05	5.59	0.01	0.01
C3	0.33	3.62	0.09	0.05
C4	0.24	4.49	0.05	0.03
C5	0.17	5.19	0.03	0.02
C6	0.30	3.77	0.08	0.05
C7	0.28	3.45	0.08	0.05
C8	0.27	3.54	0.08	0.05
C9	0.33	2.16	0.15	0.09
C10	0.28	2.54	0.11	0.07
C11	0.33	2.93	0.11	0.07
C12	0.27	4.41	0.06	0.04
C13	0.35	4.36	0.08	0.05
C14	0.31	4.34	0.07	0.04
C15	0.35	2.61	0.13	0.08
C16	0.43	2.45	0.17	0.10
C17	0.32	2.14	0.15	0.09
C18	0.10	5.17	0.02	0.01
C19	0.13	5.34	0.02	0.01
C20	0.14	4.71	0.03	0.02
C21	0.34	4.67	0.07	0.04

5.2. The Results of MPSI Procedure

The decision matrix that was employed in the first step of the application of the MPSI algorithm is shown in Table 3 and the normalized decision matrix is given in Table 4. The averages for the normalized criteria were found by Eq. (6) are reported in Table 6.

Table 6. Mean Values for Normalized Criteria

	Σ/n
C1	0.69
C2	0.93
C3	0.60
C4	0.75
C5	0.86
C6	0.63
C7	0.57
C8	0.59
C9	0.36
C10	0.42
C11	0.49
C12	0.73
C13	0.73
C14	0.72
C15	0.43

Table 6 (Cont.)

	Σ/n
C16	0.41
C17	0.36
C18	0.86
C19	0.89
C20	0.78
C21	0.78

While Eq. (7) was utilized to find the preference variation value, Eq. (8) was employed to compute the MPSI weight values, and the achieved findings are presented in Table 7.

Table 7. The Results of MPSI Procedure

	A1	A2	A3	A4	A5	A6	Σ	$w_j^{(MPSI)}$
C1	0.10	0.06	0.06	0.03	0.06	0.01	0.31	0.04
C2	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00
C3	0.16	0.07	0.16	0.04	0.08	0.05	0.56	0.07
C4	0.04	0.03	0.12	0.00	0.04	0.06	0.29	0.04
C5	0.00	0.02	0.11	0.02	0.00	0.00	0.15	0.02
C6	0.04	0.14	0.23	0.00	0.02	0.01	0.46	0.05
C7	0.01	0.01	0.03	0.15	0.18	0.00	0.38	0.05
C8	0.01	0.00	0.02	0.17	0.17	0.00	0.36	0.04
C9	0.41	0.02	0.01	0.08	0.00	0.02	0.54	0.06
C10	0.33	0.02	0.01	0.01	0.01	0.03	0.40	0.05
C11	0.26	0.07	0.05	0.10	0.00	0.06	0.54	0.06
C12	0.00	0.01	0.07	0.26	0.03	0.00	0.37	0.04
C13	0.07	0.06	0.00	0.46	0.00	0.01	0.61	0.07
C14	0.01	0.08	0.08	0.31	0.01	0.00	0.49	0.06
C15	0.04	0.02	0.32	0.13	0.02	0.09	0.62	0.07
C16	0.00	0.35	0.14	0.11	0.13	0.19	0.92	0.11
C17	0.03	0.00	0.03	0.01	0.41	0.03	0.51	0.06
C18	0.00	0.00	0.01	0.00	0.01	0.02	0.05	0.01
C19	0.01	0.01	0.01	0.04	0.01	0.00	0.08	0.01
C20	0.01	0.02	0.00	0.02	0.01	0.05	0.10	0.01
C21	0.20	0.05	0.05	0.05	0.05	0.20	0.59	0.07

5.3. Combined Weights

The optimal criteria weight values computed by applying Eq. (9) are reported in Table 8.

Table 8. Final Weight Values of Criteria

	w_j
C1	0.036
C2	0.003
C3	0.061
C4	0.034
C5	0.019

Table 8 (Cont.)

	w_j
C6	0.051
C7	0.047
C8	0.044
C9	0.078
C10	0.058
C11	0.066
C12	0.040
C13	0.061
C14	0.051
C15	0.077
C16	0.107
C17	0.075
C18	0.009
C19	0.012
C20	0.015
C21	0.058

5.4. The Results of RAWEC Procedure

The decision matrix that was utilized in the application of the RAWEC technique is demonstrated in Table 3. Next, the normalized decision matrix is form with the aid of Eq. (10) and Eq. (11). This matrix is indicated in Table 9.

Table 9. Normalized Initial Decision Matrix

	Benefit Normalisation (v_{ij})						Cost Normalisation (v'_{ij})					
	A1	A2	A3	A4	A5	A6	A1	A2	A3	A4	A5	A6
C1	1.00	0.93	0.45	0.52	0.45	0.80	0.45	0.48	0.99	0.86	1.00	0.56
C2	0.86	0.96	1.00	0.93	0.94	0.90	1.00	0.90	0.86	0.92	0.92	0.96
C3	1.00	0.86	0.20	0.41	0.31	0.83	0.20	0.24	1.00	0.50	0.65	0.25
C4	0.94	0.91	0.40	0.70	0.54	1.00	0.42	0.44	1.00	0.57	0.73	0.40
C5	0.89	1.00	0.54	1.00	0.93	0.84	0.61	0.54	1.00	0.54	0.58	0.64
C6	0.84	1.00	0.15	0.57	0.47	0.75	0.17	0.15	1.00	0.26	0.31	0.20
C7	0.46	0.50	0.74	0.18	1.00	0.57	0.40	0.36	0.25	1.00	0.18	0.32
C8	0.51	0.53	0.71	0.18	1.00	0.60	0.35	0.34	0.25	1.00	0.18	0.30
C9	1.00	0.23	0.27	0.07	0.37	0.22	0.07	0.30	0.26	1.00	0.18	0.32
C10	1.00	0.30	0.35	0.31	0.33	0.25	0.25	0.86	0.73	0.83	0.77	1.00
C11	1.00	0.76	0.27	0.18	0.47	0.25	0.18	0.23	0.65	1.00	0.38	0.71
C12	0.68	0.81	1.00	0.23	0.91	0.77	0.33	0.28	0.23	1.00	0.25	0.30
C13	1.00	0.98	0.73	0.05	0.75	0.85	0.05	0.05	0.07	1.00	0.07	0.06
C14	0.61	1.00	1.00	0.16	0.82	0.74	0.27	0.16	0.16	1.00	0.20	0.22
C15	0.24	0.57	1.00	0.07	0.59	0.14	0.31	0.13	0.07	1.00	0.12	0.51
C16	0.44	1.00	0.04	0.08	0.04	0.84	0.08	0.04	1.00	0.44	0.83	0.04
C17	0.19	0.33	0.19	0.24	1.00	0.19	1.00	0.57	1.00	0.80	0.19	1.00
C18	0.83	0.92	0.75	0.92	0.75	1.00	0.90	0.82	1.00	0.82	1.00	0.75
C19	0.77	1.00	0.98	0.70	0.98	0.92	0.91	0.70	0.72	1.00	0.72	0.76
C20	0.88	0.65	0.82	0.65	0.71	1.00	0.73	1.00	0.79	1.00	0.92	0.65
C21	0.33	1.00	1.00	1.00	1.00	0.33	1.00	0.33	0.33	0.33	0.33	1.00

After this computation, Eq. (12)-(14) are applied to obtain the deviations from the criterion weights and the values of Ω_i . The results of these calculations and the ranking orders of the alternatives are indicated in Table 10. According to the outcomes indicated in Table 10, it is observed that A2 and A1 are ranked as the top two banks, while A3 and A4 are ranked as the worst banks.

Table 10. Final Ranking Order Using the RAWEC Method

	n_{ij}	n'_{ij}	Ω_i	Rank
A1	0.32	0.64	0.34	2
A2	0.27	0.68	0.43	1
A3	0.49	0.41	-0.09	5
A4	0.69	0.22	-0.51	6
A5	0.40	0.58	0.19	3
A6	0.44	0.54	0.10	4

6. SENSITIVITY ANALYSIS

This section conducts a series of sensitivity analysis tests to demonstrate the robustness, stability and validity of the recommended combined MCDM approach. The analysis was performed in four stages. Firstly, the current study investigated the effects of changes in weight values of criteria on the ranking performance of alternatives via 100 scenarios. Secondly, the effect of changing the values of the ψ parameter on the ranking order of the alternatives is examined. Thirdly, this study examines the influence of removing each alternative on the final ranking results of the recommended framework to test its robustness. Finally, we compare the ranking results of recommended MCDM framework to those obtained by applying various MCDM approaches.

6.1. Exploring the Changes in Criteria Weights

A total of 100 scenarios were generated to assess the effects of criterion weight changes. Each scenario decreased the weight of the most influential criterion (C16) by 2%. The following equation was utilized to estimate the weights of the remaining criteria in each scenario:

$$w_n^* = w_n \frac{(1-w_{21}^*)}{(1-w_{21})} \text{ for } n \neq 16 \quad (15)$$

Here, w_n^* denotes the new value of w_n in the next scenario. For instance, for the first scenario (S1), the new weight value for C16 is obtained as follows:

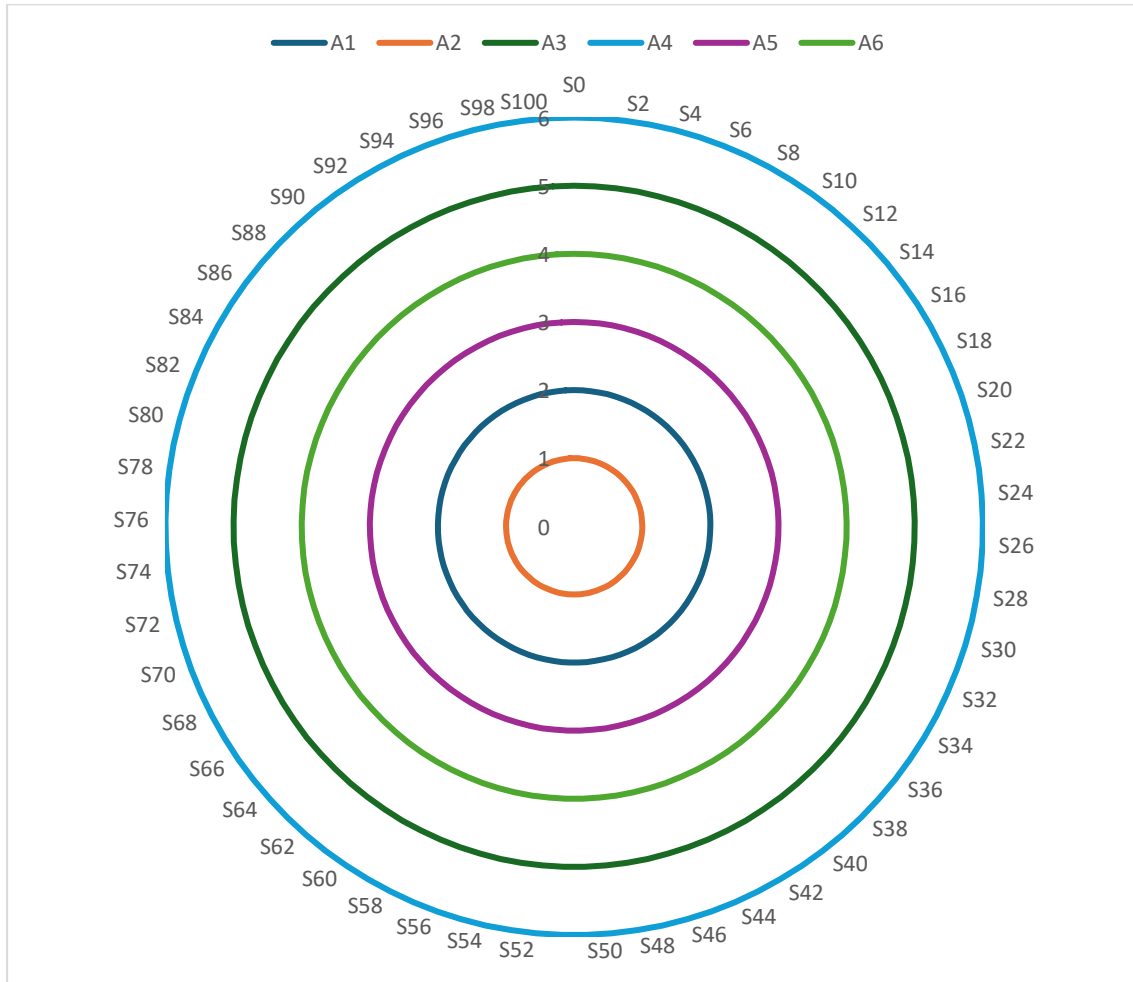
$$w_{16}^* \cong 0.1070 \times 0.98 \cong 0.1049$$

The new weight value of C1 in S1 is computed as indicated below.

$$w_1^* \cong 0.0365 \frac{(1 - 0.1049)}{(1 - 0.1070)} \cong 0.0366$$

The weights of the other 20 criteria were found by applying Eq. (15). Next, we created new weight vectors based on 100 different scenarios and tried to analyze their impact on the ranking positions of options. The alternatives were re-ranked using 100 scenarios and the results are shown in Figure 2. When Figure 2 is analyzed, it is determined that there is no change in the ranking of any alternative.

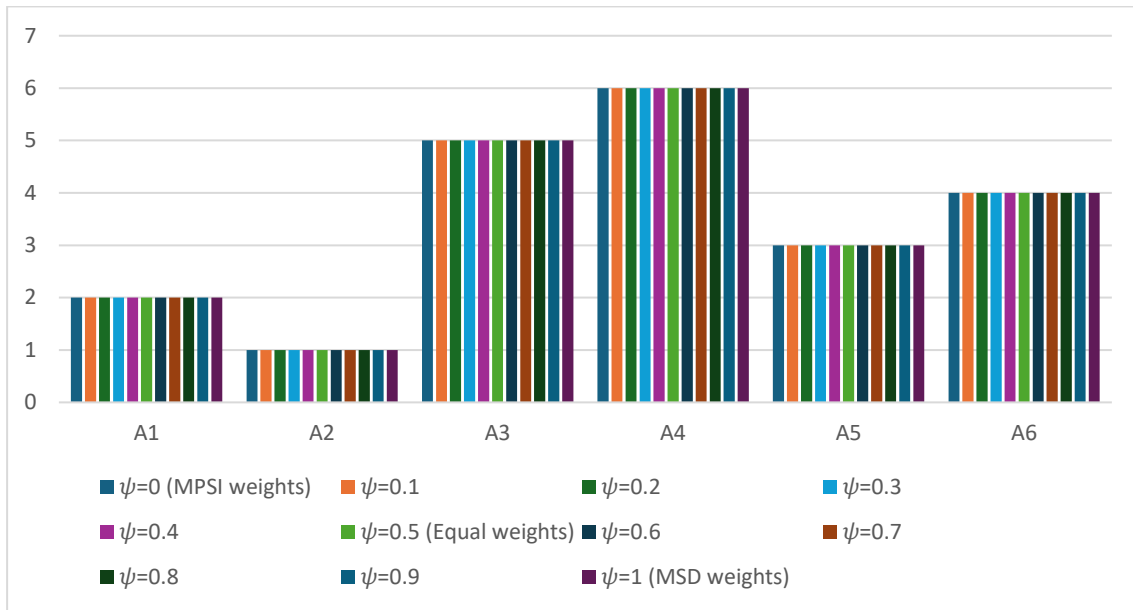
Figure 2. Re-ranking of Alternatives Based on the New Weights for Criteria



6.2. Analyzing the Impact of Changing Values of the ψ Parameter

The value of the parameter ψ was set as 0.5 to compute the integrated weights of criteria. By identifying the values of the parameter ψ as integers ranging from 1 to 10, the weight values of the criteria and their influence on the ranking of the options were investigated. The ranking orders of options with regard to the 10 scenarios are illustrated in Figure 3. When the results displayed in Figure 3 are considered, it is understood that there is no significant change in the ranking positions of the alternatives.

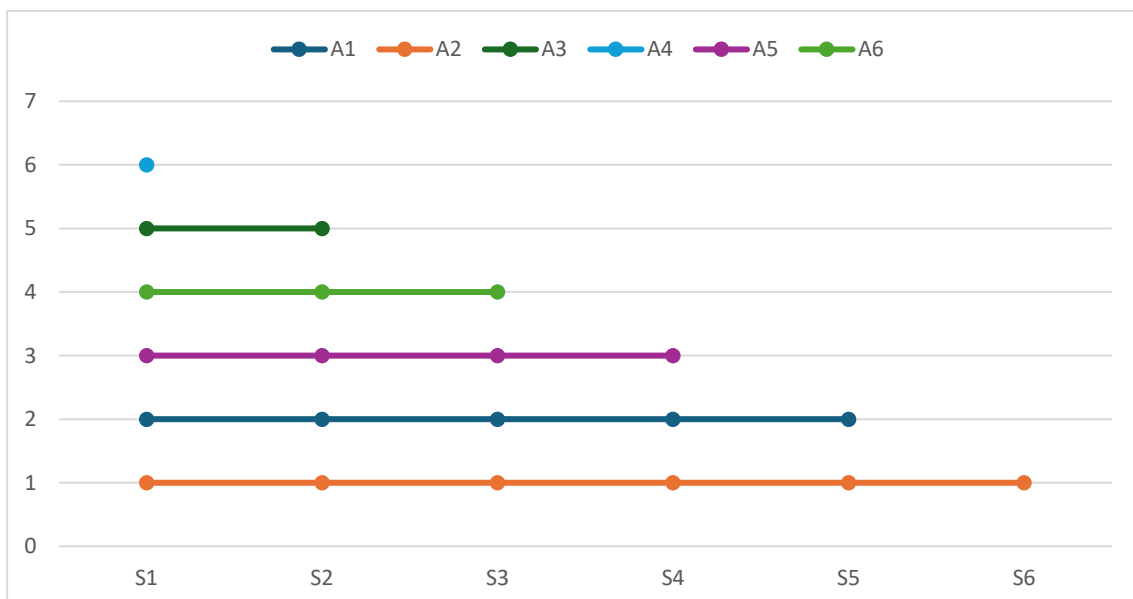
Figure 3. Re-ranking of Alternatives According to a Variety of Values of ψ Parameter



6.3. Examining the Impact of the Rank Reversal Phenomenon on the Ranking Order

To understand the effectiveness of the introduced MCDM tool to the rank reversal issue, scenarios based on the elimination of the least important alternative were developed. Accordingly, in each scenario, the worst alternatives were dropped from the analysis, respectively, until the best alternative remained. The results obtained from six scenarios based on the elimination of the least important alternative are presented in Figure 4. The findings from the scenarios based on the elimination of the least important alternative are presented in Figure 4. As can be seen in Figure 4, the elimination of the worst alternatives from the analysis does not influence the initial ranking results, which shows that the proposed MCDM tool is robust and consistent at the maximum level.

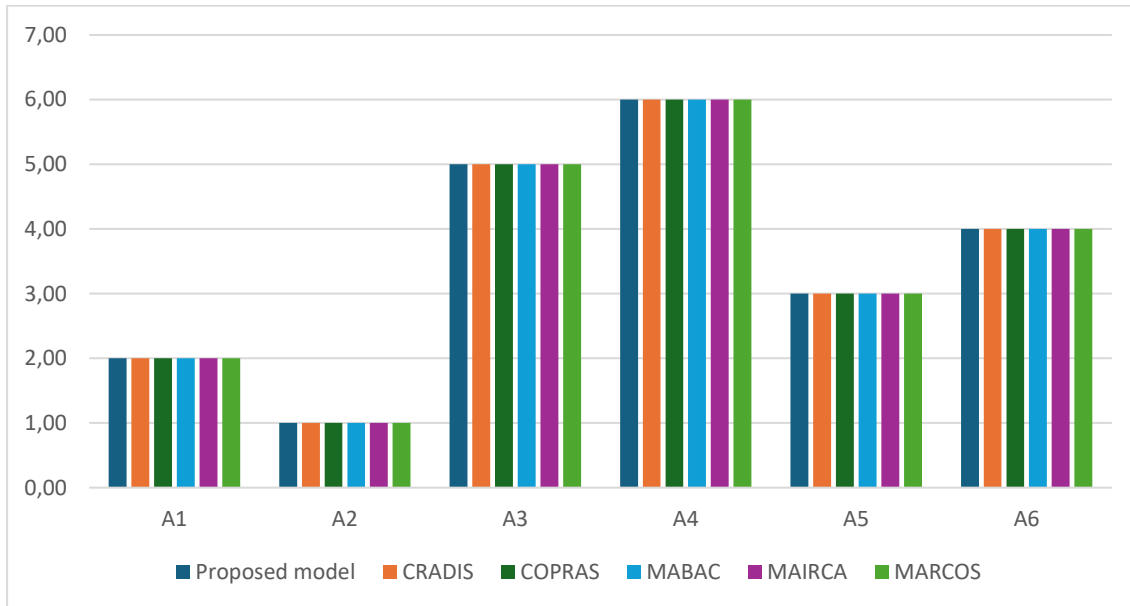
Figure 4. Alternatives' Ranking Orders Based on Various Scenarios



6.4. Comparison of the Suggested Hybrid Methodology with the Various MCDM Tools

The results achieved by the implementation of the suggested hybrid MCDM methodology are compared with the results of various MCDM methods like CRADIS (Puška et al., 2022), COPRAS (Zavadskas et al., 2001), MABAC (Pamučar and Čirović, 2015), MAIRCA (Pamučar et al., 2014), and MARCOS (Stević et al., 2020) and the results based on the comparison are shown in Figure 5. The outcomes from Figure 5 means that the suggested hybrid MCDM tool is a maximally robust and reliable.

Figure 5. Alternatives' Ranking Results According to Different MCDM Methods



7. DISCUSSION AND PRACTICAL, AND MANAGERIAL IMPLICATIONS

Assessing the overall performance of the banking industry based on financial, environmental, social and corporate governance is of great importance with regards to increasing the quality of service offered to customers, effectively managing risks and developing new products. Analyzing sustainability performance based on a solid and effective methodological framework, taking into account financial and non-financial performance indicators, makes it easier for various stakeholder groups related to the banking sector to make more practical, powerful and rational decisions.

The current paper gauging the multidimensional sustainability performance of banks has some practical implications as follows.

- The first practical contribution of the application is to provide a new and integrated framework to analyze the multidimensional sustainability performance of banks.
- The proposed decision framework has a simple and understandable mathematical procedure that DMs without advanced mathematical knowledge can easily implement.
- The combined weighting system, which integrates MSD and MPSI algorithms, contributes to obtaining more optimal results regarding the weight values of the criteria.

- The findings from sensitivity and comparative analysis demonstrate that the introduced decision tool is maximally robust and consistent.
- The proposed methodology for analyzing bank multidimensional sustainability performance is not sensitive to rank reversal, which is one of the important problems seen in MCDM applications.

The managerial implications of the current study are described below.

- The results of this study, which concentrates on the multidimensional performance of banks, one of the most significant actors of the financial intermediation process, provide critical implications for the mechanisms that regulate and supervise the banking industry, regarding the monitoring of bank performance and the sustainability of the financial system.
- Comparing the performance of banks in terms of multidimensional sustainability forms the basis of their operational and sustainability-related activities and provides vital insights concerning the success of the implemented strategies to all relevant stakeholders.
- The findings obtained through the proposed performance evaluation tool can help the bank's board of directors and senior management team to improve the banks' overall performance and achieve sustainable competitive advantage.

8. CONCLUSIONS AND DIRECTIONS FOR FUTURE RESEARCH

Due to social, environmental and governance sustainability concerns, multidimensional analysis of bank performance has become a significant and critical issue for all stakeholders in the banking sector. In the current article, an integrated MCDM model is suggested to address decision problem regarding bank multi-dimensional sustainability performance assessment. In this context, MSD-MPSI-RAWEC model are integrated for the first time.

According to the integrated weighting outcomes reported in Table 8, C16 (Total hours spent by firm-employee training), C9 (Water intensity per assets), and C15 (Employee turnover rate) are the most critical criteria influencing sustainability performance. This finding is similar to the results of Ecer (2019), Doğan and Kılıç (2022), Yıldırım and Yaman (2023), but different from the results of Alp et al. (2015), Ersoy (2018) and Bektaş (2023). On the other hand, based on the findings from the RAWEC methodology shown in Table 10, it can be concluded that A2 (Garanti BBVA) is identified as the best alternative, followed by A1 (Akbank), A5 (Vakıfbank), A6 (Yapı Kredi), A3 (Halkbank), and A4 (Şekerbank). This result is similar to the results obtained by Özçelik and Öztürk (2014), Kestane et al. (2019), Doğan and Kılıç (2022), while it is different from the results obtained by Eş and Kamacı (2020) and Bektas (2022) and Terzioğlu et al. (2023). The reason for these differences can generally be attributed to the performance criteria used in the aforementioned studies, the CRM procedures used, the sample of banks selected and the periods examined in the analyses.

Further, the accuracy and validity of the introduced methodology is checked in four phases. In the first phase, the influences of the modifications concerning the weight values of criteria on the initial alternative rank were investigated. The impact of changing values of the ψ parameter is analyzed in the second phase. In the third stage, the introduced MCDM tool's resistance to the rank reversal issue was analyzed and fourth stage and last stage of the robustness examination, the findings of introduced methodology were compared to the results of some common and robust decision-making approaches. The conducted sensitivity study's results support that the recommended MCDM tool is a stable, reliable, and resistant environment for making decisions.

The key contribution of the existing manuscript to the practitioners and researchers who work in the field of banking is to introduce a hybrid MCDM tool based on based on MSD, MPSI, and RAWEC to solve the performance assessment problem in banking industry. Another valuable contribution is presenting a novel criteria set based on financial and non-financial indicators of banks. Also, DMs can easily implement this model without advanced mathematical information and software like R, MATLAB, etc.

On the other hand, some limitations of existing manuscript exist; and these limitations can be summarized as follows: i) it can be accepted that the number of banks included in the present work is relatively low to generalize the obtained results. ii) the analysis period is limited due to the data.

For future scientific studies, we recommend that a more comprehensive performance assessment be carried out by including different indicators in the analysis process. Additionally, considering research problem, the other robust MCDM techniques such as LOPCOW, WENSLO, CoCoSo, AROMAN, ARTASI, ALWAS, etc. can be employed for analyzing bank multi-dimensional sustainability performance.

The study does not necessitate Ethics Committee permission.

The study has been crafted in adherence to the principles of research and publication ethics.

The authors declare that there exists no financial conflict of interest involving any institution, organization, or individual(s) associated with the article. Furthermore, there are no conflicts of interest among the authors themselves.

The authors contributed equally to the entire process of the research.

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Financial Performance Measurement of Companies in the BIST Sustainability 25 Index with LBWA and MEREC-based CRADIS Methods

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Abstract

Financial performance refers to the assessment of a firm's capacity to generate profits and manage its financial assets effectively during a specific period of time. This study addresses the evaluation of financial performance of companies in the BIST Sustainability 25 Index using a hybrid MCDM method. For this investigation, nine criteria, namely, acid-test ratio, asset turnover, current ratio, debt ratio, EBITDA, net profit margin, return on equity, stock return and stock turnover are used to determine the financial performance of companies. In this study, the weight of criteria is calculated using both subjective (LBWA) and objective (MEREC) weighting approaches. After the weight of criteria is determined, the financial performance of companies is ranked using the CRADIS method. The results showed that EBITDA and Stock turnover are the most and least important criteria, respectively. According to results obtained from the CRADIS method, Ereğli Iron-Steel, Enka construction and Ford Otosan have the highest financial performance, while Vestel, Arçelik and Çimsa have the lowest financial performance in the period of 2018 and 2022. Additionally, the robustness and validity of the results are tested by various MCDM methods, namely, ARAS, COPRAS, EDAS, MABAC, MAIRCA, MARCOS, TOPSIS, CoCoSo and MAUT.

Keywords: *Financial performance, Sustainability, BIST, MCDM.*



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1. INTRODUCTION

In today's competitive environment, financial performance evaluation of company holds significant importance not only for managers, creditors, and current/potential investors but also for companies operating within the same sector. Company performance measurement typically occurs within the framework of financial analyses. The concept of financial performance encompasses various aspects such as return, productivity, output, and economic growth. Utilizing financial ratios in the performance evaluation process can be suitable for both companies and related sectors. Financial ratios derived from data in income statements and balance sheets, serve as crucial measurement tools in evaluating the performance and financial assets of companies. Furthermore, the importance of financial ratios also lies in their ability to reveal the strengths and weaknesses of companies in terms of liquidity, growth, and profitability. (Yalcin et al., 2012, p. 350). Financial ratio analysis has been pivotal over the years in offering a comprehensive perspective on a company's financial position at any moment or period of time (Muresan & Wolitzer, 2004). Assessing firm performance through financial ratios has been a conventional yet effective method for decision-makers, business analysts, creditors, investors, and financial managers. Instead of relying solely on the total amounts recorded in financial statements, these analyses were conducted using various financial ratios to derive more meaningful results. Ratio analysis serves as a valuable tool for stakeholders to assess the financial well-being of a company. By utilizing these financial ratios, comparisons can be made among companies within the same industry, across different industries, or even within the same firm over time. Additionally, this tool enables the comparison of the relative performance of companies of varying sizes (Delen et al., 2013, p. 3970).

Financial performance measurement encompasses numerous evaluation criteria, rendering it a form of Multi-Criteria Decision-Making (MCDM) problem. MCDM analysis identifies the optimal alternative by taking into account multiple criteria or factors that affect the other options (Dong et al., 2018, Wen et al., 2020; Lam et al., 2021). Kara et al. (2024) highlighted that MCDM techniques offer the chance to aggregate and assess different perspectives and criteria within a single framework. Over the last decades, many studies have reported that MCDM techniques are extensively employed in the evaluation of financial performances of companies using various ratio indicators (Akbulut & Rençber, 2015; Aytakin, 2019; Aldalou & Perçin, 2020; Pala, 2022; Isık et al., 2024). Several financial ratios, including the acid-test ratio, asset turnover, current ratio, debt ratio, EBITDA, net profit margin, return on equity, stock return, and stock turnover, are regarded as primary indicators in financial performance measurement (Kaya et al., 2024). Correspondingly, this study aims to evaluate the financial performances of companies in the BIST Sustainability 25 Index using hybrid MCDM methods. To achieve this goal, a new model was proposed which includes both subjective (LBWA) and objective (MEREC) weighting approaches with new ranking-based method (CRADIS). Objective approaches involve determining the weights of criteria based on information contained in a decision-making matrix using specific mathematical formulations. It typically disregards the decision-maker's opinion. In a

subjective approach, the decision-maker or experts provide their opinions on the significance of criteria for a particular decision-making process, aligned with their system of preferences (Pamučar et al., 2018, p. 3). According to Paramanik et al. (2022), the objective and subjective criteria weights should be integrated to leverage the advantages of both approaches. Subsequently, the companies in the BIST Sustainability 25 Index are ranked using the recent ranking method called CRADIS. Furthermore, the reliability and robustness of the proposed model are tested through comparative analysis, including MAIRCA, SPOTIS, MABAC, RSMVC, MAUT, MARCOS, ARAS and TOPSIS. To the best of the author's knowledge, this is the first study to evaluate the financial performance of companies in the BIST Sustainability 25 Index using the LBWA and MEREC-based CRADIS methods. The rest of this paper is structured as follows: The second section summarizes the literature review in the relevant field. The third section is associated with the methodology. The fourth section presents the findings of the research. Finally, the fifth section concludes the paper with a brief summary and discuss the future work.

2. LITERATURE REVIEW

In this section, a comprehensive literature review is conducted to understand trends regarding financial performance measurement. Evaluating financial performance is crucial for companies operated in various industry, as it serves as a fundamental tool for assessing the effectiveness of management strategies, identifying areas for enhancement, make well-informed decisions and maintaining competitiveness in the marketplace. Correspondingly, in the last decades, the amount of research has increased significantly on relevant field. Table 1 and 2 provides a summary of previous research on financial performance measurement and overview of the methods applied in this study, respectively.

Table 1. Overview of previous research on financial performance

Author(s)	Year	Methods	Topic	Period
Akbulut and Rençber	2015	TOPSIS	Financial performance measurement of BIST Manufacturing industry	2010-2012
Önder and Altıntaş	2017	GRA-ANP	Performance measurement of BIST Construction industry	2012-2015
Şit et al.	2017	TOPSIS	Analysis of the financial performance of BIST Main Metal industry	2011-2015
Üçüncü et al.	2018	TOPSIS	Investigation of financial performance of BIST Paper industry	2016
Tayyar et al.	2018	RIM	Financial performance analysis of BIST Insurance industry	2015-2017
Kayalı and Aktaş	2018	TOPSIS	Performance measurement of BIST Automotive industry	2010-2015
Karaođlan and Şahin	2018	AHP-VIKOR-TOPSIS-GRAMOORA	Examining the financial performance of BIST Chemical, Petroleum Plastic industry	2015
Aytekin	2019	CRITIC-MAUT-PROMETHEE-TOPSIS	Investigation of financial performance of BIST Tourism industry	2014-2018
Şahin and Karacan	2019	GRA-TOPSIS	Financial performance measurement of BIST Construction industry	2017
Özçelik and Küçükçakal	2019	TOPSIS	Analysis of the financial performance of BIST Leasing and Factoring industry	2009-2016

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Yıldırım and Altan	2019	Entropy-TOPSIS	Evaluation of the financial performance of Insurance industry	2012-2016
Atukalp	2019	MULTIMOORA	Performance measurement of BIST Cement industry	2013-2017
Ayçin and Güçlü	2020	Entropy-MAIRCA	Analysis of the financial performance of BIST Trade industry	2018
Karcioğlu et al.	2020	Fuzzy logic and Entropy	Examining the financial performance of BIST Energy industry	2013-2017
Orhan et al.	2020	CRITIC-TOPSIS	Financial performance analysis of BIST Transportation industry	2011-2018
Bağcı and Yerdelen Kaygın	2020	Entropy-ARAS-WASPAS	Assessment of the financial performance of BIST Holding and Investment industry	2000-2017
Aldalou and Perçin	2020	FSE-FEDAS	Financial performance measurement of BIST Food and Beverage industry	2015-2017
Yıldırım et al.	2021	GRA	Investigation of financial performance of BIST Iron and Steel industry	2011-2019
Demir	2021	SWARA-COPRAS-MAUT	Financial performance analysis of BIST Cement industry	2014-2019
Gürkan and Aldoury	2021	TOPSIS	Examining the financial performance of BIST Technology industry	2017-2019
Baydaş and Elma	2021	Entropy, TOPSIS-WSA-PROMETHEE	Financial performance measurement of BIST Manufacturing industry	2014-2018
Elmas and Özkan	2021	SWARA-OCRA	Investigation of financial performance of BIST Transport and Storage industry	2015-2019
Yıldırım and Meydan	2021	IF-EDAS	Assessment of the financial performance of BIST Retail and Trade industry	2017-2019
Özkan and Ağ	2021	CRITIC-ARAS	Investigation of corporate sustainability performance of manufacturing companies in the BIST Sustainability Index.	2019
Babacan and Tuncay	2022	SWARA-AHP-TOPSIS	Analysis of the financial performance of BIST Energy industry	2014-2020
Özdemir and Parmaksız	2022	TOPSIS-EDAS	Comparison of the financial performance of BIST Energy industry	2019-2020
Pala	2022	CRITIC-MULTIMOOSRAL	Financial performance analysis of BIST Insurance industry	2019-2020
Bektaş	2023	MEREC-MABAC-CoCoSo	Examining the financial performance of BIST Insurance industry	2021
Doğan and Karaçayır	2023	CRITIC-TOPSIS-MABAC	Assessment of the financial performance of BIST Technology industry	2019-2022
Kara and Şeyranlıoğlu	2023	Entropy-GRA	Comparison of the performance of companies in the BIST Sustainability Index	2020-2022
Ersoy	2023	LOPCOW-RSMVC	Performance measurement of BIST Retail and Trade industry	2017-2021
Uğuz Arsu and Arsu	2023	MEREC-CoCoSo	Analyze the performance of Manufacturing industry in the BIST Sustainability Index	2020
Coşkun	2023	TOPSIS	Evaluation of financial performance of BIST Sustainability Index companies	2010-2022
Isık et al.	2024	DEMATEL-CRITIC-EDAS-WASPAS-TOPSIS	Stock market performance analysis of BIST Food and Beverage industry	2021-2022
Güçlü and Muzac	2024	Grey MULTIMOORA	Financial performance analysis of BIST Iron and Steel industry	2017-2021
Kaya et al.	2024	FUCOM- Nine MCDM methods	Determining the financial performance of companies traded in BIST Sustainability Index.	2019-2020

Note: Technique for Order Preference by Similarity to Ideal Solution (TOPSIS); Grey Relational Analysis (GRA); Analytic Network Process (ANP); Reference Ideal Method (RIM); Analytic Hierarchy Process (AHP); Vise Kriterijumska Optimizacija I Kompromisno Resenje (VIKOR); Multi-Objective Optimization on the basis of Ratio Analysis (MOORA); Criteria Importance Through Intercriteria Correlation (CRITIC); Multi Attribute Utility Theory (MAUT); Preference Ranking Organization Method for Enrichment Evaluation (PROMETHEE); Multi-Objective Optimization by Ration Analysis plus Full Multiplicative Form (MULTIMOORA); MultiAtributive Ideal-Real Comparative Analysis (MAIRCA); Additive Ratio Assessment (ARAS); Weighted Aggregated Sum Product Assessment (WASPAS); Fuzzy Shannon Entropy (FSE); Fuzzy Evaluation Based on Distance from Average Solution (FEDAS); Stepwise Weight Assessment Ratio Analysis (SWARA); Complex Proportional Assessment (COPRAS); Operational Competitiveness Rating (OCRA); Evaluation Based on Distance from Average Solution (EDAS); Multi-Multi-Objective Optimization on the basis of Simple Ratio Analysis (MULTIMOOSRAL); Method based on the Removal Effects of Criteria (MERECE); Multi-Attributive Border Approximation Area Comparison (MABAC); A Combined Compromise Solution (CoCoSo); Logarithmic Percentage Change-driven Objective Weighting (LOPCOW); Ranking the Solutions based on the Mean Value of Criteria (RSMVC); Decision Making Trial and Evaluation Laboratory (DEMATEL), Full Consistency Method (FUCOM)

Table 2. Overview of previous research on methods

Author(s)	Year	Method	Topic
Božanić et al.	2020	LBWA	Selection of a location of a camp
Torkayesh et al.	2021	LBWA	Evaluation of healthcare sectors in Eastern Europe
Jokić et al.	2021	LBWA	Selection of fire position of mortar units
Torkayesh and Torkayesh	2021	LBWA	Evaluation of information and communication technology development in G7 countries
Adali et al.	2022	LBWA	Assessment of European cities from a smartness perspective
Božanić et al.	2023	LBWA	A decision support tool for oil spill response strategy selection
Özekenci	2024	LBWA	Personnel Selection: A Case Study on Foreign Trade Company
Author(s)	Year	Method	Topic
Ulutaş et al.	2022	MERECE	Pallet truck selection in the textile workshop
Ecer and Zolfani	2022	MERECE	Evaluating economic freedom: The case of OPEC countries
Ulutaş et al.	2023a	MERECE	Identifying the Most Efficient Natural Fibre for Common Commercial Building Insulation
Ecer and Aycin	2023	MERECE	Measuring Innovation Performance: The Case of G7 Countries
Lukić	2023	MERECE	Analysis of the performance of the Serbian economy
Kara et al.	2024	MERECE	Determining sustainable competitiveness levels: A case study for Turkey
Mastilo et al.	2024	MERECE	Assessing the Banking Sector of Bosnia and Herzegovina
Author(s)	Year	Method	Topic
Puška et al.	2022	CRADIS	Market Assessment of Pear Varieties in Serbia
Ulutaş et al.	2023b	CRADIS	Optimizing energy usage and environmental effect in production focus
Puška et al.	2023	CRADIS	Selection of an Insurance Company in Agriculture
Krishankumar and Ecer	2023	CRADIS	Selection of IoT service provider for sustainable transport
Xu et al.	2023	CRADIS	Assessment of Mountain Tourism Sustainability
Krishankumar et al.	2024	CRADIS	Selection of a viable blockchain service provider for data management within the internet of medical things
Aytekin et al.	2024	CRADIS	Determining the factors affecting transportation demand management

Note: Level Based Weight Assessment (LBWA); Method based on the Removal Effects of Criteria (MERECE); Compromise Ranking of Alternatives from Distance to Ideal Solution (CRADIS)

It can be seen above; a considerable amount of research has been published on financial performance measurement of companies traded in BIST using different MCDM methods. For instance,

manufacturing (Akbulut & Rençber, 2015; Baydaş & Elma, 2021), construction (Önder & Altıntaş, 2017; Şahin & Karacan, 2019), insurance (Tayyar et al., 2018; Yıldırım & Altan, 2019; Pala, 2022), energy (Karcıoğlu et al., 2020; Özdemir & Parmaksız, 2022), technology (Gürkan & Aldoury, 2021; Doğan & Karaçayır, 2023), food and beverage (Aldalou & Perçin, 2020; Işık et al., 2024), cement (Atukalp, 2019; Demir, 2021), retail and trade (Yıldırım & Meydan, 2021; Ersoy, 2023), iron and steel (Yıldırım et al., 2021; Güçlü & Muzac, 2024) industries have been investigated by many researchers. In recent years, due to the increase awareness and concerned on environmental issues, several researchers have focused on analyzing the financial and corporate performances of companies traded in the BIST Sustainability Index (Özkan & Ağ, 2021; Kara & Seyranlıoğlu, 2023; Coşkun, 2023; Uğuz Arsu & Arsu, 2023; Kaya et al., 2024). Much of the current literature on evaluation of financial performance was carried out either with a subjective or objective approach. However, no studies have been found which evaluate the financial performance of companies using both objective and subjective approach. The fact that the use of objective and subjective approach in MCDM studies provides more reliable and comprehensive results (Parameshwaran et al., 2015; Marković et al., 2020; Özekenci, 2023). Accordingly, this study aims to contribute to existing literature by proposing a new model that includes both subjective (LBWA) and objective (MEREC) approach with new ranking-based MCDM method (CRADIS).

3. METHODOLOGY

This study investigated firms' financial performances using different MCDM methods. This research used 11 MCDM methods together. The LBWA and MEREC methods are conducted to determine the weight of the criteria, CRADIS method is used to rank the alternatives, and finally eight methods, namely, ARAS, COPRAS, EDAS, MABAC, MAIRCA, MARCOS, TOPSIS, CoCoSo and MAUT are used to comparison of the results. Additionally, in this study, Artificial Intelligence (AI) tools are utilized to enhance the quality of manuscript regarding the proofreading and editing. Table 3 demonstrates the financial performance indicators and MCDM techniques used in this study.

Table 3. Indicators and methods

Performance indicators	Weighting determination	MCDM techniques
Acid-test ratio		
Asset turnover	LBWA	CRADIS
Current ratio	(Subjective)	
Debt ratio		
Ebitda	MEREC	Comparison with other MCDM tools:
Net profit margin	(Objective)	ARAS, COPRAS, EDAS, MABAC, MAIRCA, MARCOS, TOPSIS, CoCoSo, MAUT
Return on equity		
Stock return	AWM	
Stock turnover	(Combined)	

3.1. LBWA

Level Based Weight Assessment (LBWA) method was developed by Žižović and Pamučar in 2019. The LBWA is one of the recent subjective approaches to calculate the weight of criteria. The application steps of the LBWA method are as follows (Žižović & Pamučar, 2019):

Step 1. At first, the most important criterion from the set of criteria is determined.

Step 2. Then, criteria are classified based on significance levels:

Level S_1 : At the level S_1 group the criteria from the set S whose significance is equal to the significance of the criterion C_1 or up to twice as less as the significance of the criterion C_1 ;

Level S_2 : At the level S_2 group the criteria from the set S whose significance is exactly twice as less as the significance of the criterion C_1 or up to three times as less as the significance of the criterion C_1 ;

Level S_3 : At the level S_3 group the criteria from the set S whose significance is exactly three times as less as the significance of the criterion C_1 or up to four times as less as the significance of the criterion C_1 ;

Level S_k : At the level S_k group the criteria from the set S whose significance is exactly k times as less as the significance of the criterion C_1 or up to $k+1$ as less as the significance of the criterion C_1 .

According to the rules mentioned above, the decision-maker classifies the observed criteria in rough form using Eq. (1).

$$Si = \{C_{i_1}, C_{i_2}, \dots, C_{i_s}\} = \{C_j \in S: i \leq s(C_j) < i + 1\} \quad (1)$$

Step 3. Eq. (2) is used to comparison of criteria through their significance within the created subgroups (levels) of the criteria's influence.

$$r = \max\{|S_1|, |S_2|, \dots, |S_k|\} \quad (2)$$

Step 4. The elasticity coefficient is defined based on the maximum value of the scale for the comparison of criteria (r).

Step 5. According to Eq. (3), the influence function of the criteria is computed.

$$f(C_{i_p}) = \frac{r_0}{i \cdot r_0 + I_{i_p}} \quad (3)$$

Step 6. By applying Eq. (4), the optimum values of the weight coefficient of criteria are calculated.

$$w_i = \frac{1}{f(C_2) + \dots + f(C_n)} \quad (4)$$

Based on Eq. (5), the values of the weight coefficient of the remaining criteria are determined.

$$w_j = f(C_j) \cdot w_1 \quad j=2, 3, \dots, n \quad (5)$$

3.2. MEREC

Method based on the Removal Effects of Criteria (MEREC) method was developed by Keshavarz-Ghorabae et al. in 2021. It's a new objective weighting method for calculating the criteria weights. It utilizes each criterion's removal effect on the performance of alternatives to calculate the criteria weights. The steps of the MEREC method are as follows (Ghorabae et al., 2021):

Step 1. The decision matrix is constructed.

Step 2. The decision matrix is normalized using Eqs. (6-7).

$$N_{ij} = \left\{ \frac{\min_{x_{kj}}}{x_{ij}} \right\} \text{ if } j \in B \quad (6)$$

$$N_{ij} = \left\{ \frac{x_{ij}}{\max_{x_{kj}}} \right\} \text{ if } j \in B \quad (7)$$

Step 3. The overall performance of the alternatives (S_i) is calculated based on Eq. (8).

$$S_i = \ln \left(1 + \left(\frac{1}{m} \sum_j |\ln(N_{ij})| \right) \right) \quad (8)$$

Step 4. According to Eq. (9), the performance of the alternatives by removing each criterion is computed.

$$S'_{ij} = \ln \left(1 + \left(\frac{1}{m} \sum_{k, k \neq j} |\ln(N_{ik})| \right) \right) \quad (9)$$

Step 5. The summation of absolute deviations is calculated by Eq. (10).

$$E_j = \sum_i |S'_{ij} - S_i| \quad (10)$$

Step 6. The final weights of criteria are determined using Eq. (11).

$$w_i = \frac{E_i}{\sum_K E_k} \quad (11)$$

3.3. Aggregated Weighting Method (AWM)

According to Eq. (12), the aggregated weight is calculated (Ighravwe & Babatunde, 2018; Ali et al., 2020)];

$$W_{Aggregated} = \Delta W_{sj} + (1 - \Delta)W_{oj} \quad (12)$$

where W_{sj} and W_{oj} represent the subjective and objective weights of the criteria, respectively and Δ symbolizes the contribution factor. Keshavarz Ghorabae et al. [2017] suggested using values of Δ from 0 to 1. For this study, $\Delta = 0.5$ was considered.

3.4. CRADIS

Compromise Ranking of Alternatives from Distance to Ideal Solution (CRADIS) method was proposed by Puška et al. in 2021. This method is a combination of steps regarding various MCDM techniques, such as ARAS, MARCOS and TOPSIS. The steps of the CRADIS method are shown below (Puška et al., 2021):

Step 1. The decision matrix is created.

Step 2. The decision matrix is normalized by Eqs. (13-14).

$$n_{ij} = \frac{x_{ij}}{x_{jmax}} \quad (13)$$

$$n_{ij} = \frac{x_{jmin}}{x_{ij}} \quad (14)$$

Step 3. Based on Eq. (15), the aggravated decision matrix is obtained.

$$v_{ij} = n_{ij} \cdot w_j \quad (15)$$

Step 4. The ideal and anti-ideal solution is determined using Eqs. (16-17).

$$t_i = \max v_{ij} \quad (16)$$

$$t_{ai} = \min v_{ij} \quad (17)$$

Step 5. The deviations from ideal and anti-ideal solutions are computed based on Eqs. (18-19).

$$d^+ = t_i - v_{ij} \quad (18)$$

$$d^- = v_{ij} - t_{ai} \quad (19)$$

Step 6. According to Eqs. (20-21), the grades of the deviation of individual alternatives from ideal and anti-ideal solutions are determined.

$$s_i^+ = \sum_{j=1}^n d^+ \quad (20)$$

$$s_i^- = \sum_{j=1}^n d^- \quad (21)$$

Step 7. Based on Eqs. (22-23), the utility function for each alternative is calculated.

$$K_i^+ = \frac{s_0^+}{s_i^+} \quad (22)$$

$$K_i^- = \frac{s_i^-}{s_0^-} \quad (23)$$

Step 8. The final order is obtained using Eq. (24).

$$Q_i = \frac{K_i^+ + K_i^-}{2} \quad (24)$$

The best alternative is the one that has the greatest value Q_i

4. RESULTS

The current study addresses the financial performances of the 10 firms in the BIST Sustainability 25 Index for the period of 2018-2022. This study conducted numerous MCDM techniques to analyze companies' financial performance using several performance indicators. While there has been a significant growth in the number of MCDM techniques in recent years, identifying the most suitable and accurate methods for any decision problem remains challenging (Kiptum et al., 2022; Kaya et al., 2024). Therefore, this study applied various MCDM techniques for calculating the weight of the criteria, and to rank the alternatives. For this investigation, data were gathered from Finnet data platform, and the performance indicators were determined through literature review and expert opinions. Table 4 and 5 provides a brief synopsis of the criteria, and background of the experts involved in this study.

Table 4. Overview of performance indicators

Criteria	Abb.	Optimization	Formulas	References
Acid-test ratio	C_1	max	(Current Assets-Inventories)/Current liabilities	Katchova and Enlow (2013)
Asset turnover	C_2	max	Net sales revenue/Average total assets	Karimi and Barati (2018)
Current ratio	C_3	max	Current assets/Current liabilities	Aras et al. (2018)
Debt ratio	C_4	min	Total debts/Total assets	Yıldırım and Altan (2019)
Ebitda	C_5	max	Operating profit + Depreciation + Amortization	Atukalp (2019)
Net profit margin	C_6	max	Earnings after taxes/Sales	Yıldırım and Meydan (2021)
Return on equity	C_7	max	Net income/Average shareholders' equity	Pala (2022)
Stock return	C_8	max	$R_t = (P_t - P_{(t-1)}) / P_{(t-1)}$	Baydas and Pamučar (2022)
Stock turnover	C_9	max	Stock holding period = Avg. level of stock x 12 / Annual sales (turnover)	Ersay (2023) Doğan and Karaçayır (2023) Kaya et al. (2024)

Table 5. Background of the Expert Group

No	Gender	Experience	Expertise	Occupation	Educational Status
<i>DM₁</i>	Male	15-20 years	Accounting	Private sector / Manager	Master degree
<i>DM₂</i>	Female	10-15 years	Finance	Private sector / Manager	Master degree
<i>DM₃</i>	Male	25-30 years	Financial Management	Academician / Prof. Dr.	Ph.D.
<i>DM₄</i>	Female	15-20 years	International Finance	Academician / Assoc. Prof.	Ph.D.

The indicators used in this study was chosen due to their importance on financial performances. For instance, stock return and return on equity are the most significant ratios for financial performance measurement (Kaya et al., 2024). According to Baydas and Pamučar (2022), the most commonly used ratios for assessing a firm's future risks and financial performance are the current ratio and the acid-test ratio. Ghosh and Bhattacharya (2022) emphasized that financial analysts and investors frequently rely on the current ratio as a crucial measure of liquidity. Furthermore, the net profit margin plays a pivotal role in evaluating of the firm's financial and operational performance (Estiasih & Putra 2021). Aytekin (2019) specified that aforementioned performance indicators have been extensively used to evaluate the financial performance of companies using MCDM methods. Thus, it can be concluded that the indicators used in this study are effective for financial performance measurement. In this study, the financial performances of companies in the BIST Sustainability 25 Index were evaluated. As of March 2024, there are 22 companies listed in the BIST Sustainability 25 Index (excluding banks since the differing nature of their financial statements compared to other firms). Due to the unavailability of data, the analysis was conducted with 10 companies, and the overview of companies are presented in Table 6.

Table 6. BIST Sustainability 25 Index List

No	Code	Company Name	Industry
1	ARCLK	Arçelik Inc.	Manufacturing
2	CIMSA	Çimsa Cement Industry and Trade Inc.	Manufacturing
3	ENJSA	Enerjisa Energy Inc.	Electricity, Gas and Water
4	ENKAI	Enka Construction and Industry Inc	Construction and Public Works
5	EREGL	Ereğli Iron and Steel Factories Co. Inc..	Manufacturing
6	FROTO	Ford Automotive Industry Inc.	Manufacturing
7	PETKM	Petkim Petrochemical Inc.	Manufacturing
8	TOASO	Tofaş Turkish Automobile Factory Inc.	Manufacturing
9	TTRAK	Turkish Tractor and Agricultural Machinery Inc.	Manufacturing
10	VESTL	Vestel Electronics Industry and Trade Inc.	Manufacturing

Upon clarification of the criteria and alternatives, an expert group of four individuals were formed, including two academicians teaching course regarding the finance management and two financial managers from different companies. As stated by Kara (2024), expert opinions play a critical role in determining the sector-specific importance levels of financial ratio indicators. Obtaining expert opinions is essential for the implementation of the first criterion weighting process. As depicted in Table 4, the experts were determined based on their professional experience and knowledge in financial

analyses. Consequently, it is apparent that the selection criteria align with the expertise areas of the participating individuals in the study.

4.1. The results obtained by the LBWA Method

The first step of applying the LBWA method is creating the criterion set. The criteria set which involves nine criteria was formed as follow; $S = \{C_1, C_2, C_3, C_4, C_5, C_6, C_7, C_8, C_9\}$ ({Acid-test ratio, Asset turnover, Current ratio, Debt ratio, EBITDA, Net profit margin, Return on equity, Stock return and Stock turnover}). According to the opinions of the expert group, the most important criterion was determined as C_5 (EBITDA). Indicator C_5 was regarded as most important criteria by more than 80% of the experts. After that, the criterion levels were created by comparing each criterion with the most important criterion. Based on Eq. (1), the criteria were categorized into two levels (S_1 and S_2) through their relative importance and shown as follows: $S_1 = \{C_3, C_4, C_5, C_6, C_7, C_8\}$ and $S_2 = \{C_1, C_2, C_9\}$. After assigning values to each criterion, the r value was computed by Eq. (2). Then, Eqs. (3-5) were used to the elasticity coefficient (r_0), the influence function of the criteria (f) and value of the weight coefficient (w), respectively. According to Žižović and Pamučar (2019), the elasticity coefficient should be $r_0 > r$. For this reason, the value of the elasticity coefficient (r_0) was considered as $r_0 = 7$. The influence functions of the criteria and the final weights of the criteria are shown in Table 7.

Table 7. The results of LBWA method

Criteria	Assigned Value	The influence function	The weights of the criteria
<i>Level S_1</i>	<i>I</i>	<i>f</i>	<i>w</i>
C_3	1	0.9091	0.1487
C_4	2	0.8333	0.1363
C_5	0	1.0000	0.1636
C_6	5	0.6667	0.1090
C_7	4	0.7143	0.1168
C_8	6	0.6250	0.1022
Criteria	Assigned Value	The influence function	The weights of the criteria
<i>Level S_2</i>	<i>I</i>	<i>f</i>	<i>w</i>
C_1	1	0.4762	0.0779
C_2	2	0.4545	0.0743
C_9	3	0.4348	0.0711

Consequently, the vector of the weight coefficient was obtained as follows: $w_j = (0.0779; 0.0743; 0.1487; 0.1363; 0.1636; 0.1090; 0.1168; 0.1022; 0.0711)$. The results of the LBWA method indicated that EBITDA (C_5), current ratio (C_3) and debt ratio (C_4) were the most important criteria, while stock turnover (C_9) asset turnover (C_2) and acid-test ratio (C_1) were the least important criteria, respectively.

4.2. The results obtained by the MEREC Method

Since there are negative values in the decision matrix (App-1), the values should be converted into positive one. In this direction, the negative values were transformed positive using the Z-Score normalization method which is developed by Zhang et al. (2014). As mentioned above, this study

addresses the evaluate the financial performance of companies for 5 years. However, since the calculations are very long and complex, only the findings for 2022 are included in this section. After the decision matrix (Table 8) was formed, the decision matrix was normalized through Eqs. (4-5), and its results shown in Table 9.

Table 8. Decision Matrix (2022)

Alternatives/ Criteria	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9
ARCLK	0.7642	2.4081	1.1766	75.0285	1.62E+10	2.4441	17.4179	1.4745	5.6053
CIMSA	0.9415	2.0988	1.1899	47.3336	1.24E+09	39.9857	83.5969	2.3003	5.9572
ENJSA	0.6514	4.8553	0.7036	63.55	8.66E+09	17.1679	93.7682	2.5749	51.8715
ENKAI	2.0627	0.9212	2.3863	23.7059	1.40E+10	3.1734	1.8680	1.5359	8.2590
EREGL	0.9045	1.7463	2.2462	32.1518	2.67E+10	14.0903	18.1926	2.4214	2.2437
FROTO	0.8135	5.1969	1.1984	70.6600	3.20E+10	8.5969	90.4873	2.5696	19.3125
PETKM	0.9324	1.8101	1.1028	65.1331	3.39E+09	13.4570	41.4542	2.7091	8.9823
TOASO	1.1535	3.4755	1.2835	64.9737	1.81E+10	7.5585	59.3435	2.3524	25.4202
TTRAK	0.7543	3.3943	1.2806	64.4528	4.91E+09	10.4108	76.3109	5.2296	9.5145
VESTL	0.3409	2.3436	0.6156	79.0145	6.18E+09	1.4677	8.0029	1.8323	3.2967

Table 9. Normalized Decision Matrix

Alternatives/ Criteria	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9
ARCLK	0.8524	0.3825	0.5980	0.3160	0.0762	1.0000	0.1072	1.0000	0.4003
CIMSA	0.6919	0.4389	0.5913	0.5008	1.0000	0.0611	0.0223	0.6410	0.3766
ENJSA	1.0000	0.1897	1.0000	0.3730	0.1427	0.1424	0.0199	0.5726	0.0433
ENKAI	0.3158	1.0000	0.2949	1.0000	0.0884	0.7702	1.0000	0.9600	0.2717
EREGL	0.7202	0.5275	0.3132	0.7373	0.0464	0.1735	0.1027	0.6089	1.0000
FROTO	0.8008	0.1773	0.5871	0.3355	0.0386	0.2843	0.0206	0.5738	0.1162
PETKM	0.6987	0.5089	0.6380	0.3640	0.3645	0.1816	0.0451	0.5443	0.2498
TOASO	0.5648	0.2650	0.5482	0.3649	0.0682	0.3234	0.0315	0.6268	0.0883
TTRAK	0.8636	0.2714	0.5494	0.3678	0.2515	0.2348	0.0245	0.2819	0.2358
VESTL	1.9108	0.3931	1.1430	0.3000	0.1999	1.6653	0.2334	0.8047	0.6806

Eq. (6) was used to calculate the overall performance of each alternative, and shown in Table 10.

Table 10. The overall performance values of the alternatives (S_i)

Alternatives	S_i
ARCLK	0.6655
CIMSA	0.7694
ENJSA	0.9452
ENKAI	0.5375
EREGL	0.7487
FROTO	0.9673
PETKM	0.7631
TOASO	0.9241
TTRAK	0.8615
VESTL	0.5813

After the overall performance of alternative was computed, the partial performance of each alternative was determined using Eq. (7), and its results presented in Table 11.

Table 11. The partial performance values of the alternatives (S_{ij})

Alternatives	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9
ARCLK	0.4561	0.3981	0.4309	0.3837	0.2698	0.7931	0.4521	0.7931	0.6670
CIMSA	1.0468	1.0289	1.0406	1.0341	1.0610	0.2372	0.2372	0.2372	0.2372
ENJSA	1.1505	1.0903	1.1505	1.1152	1.0796	1.0790	0.9227	1.1764	0.9873
ENKAI	0.3676	0.4526	0.3623	0.4526	0.2645	0.4862	0.5286	0.5221	0.2965
EREGL	0.7489	0.7324	0.7042	0.7502	0.5933	0.7959	0.7117	0.9726	1.0347
FROTO	0.9764	0.9112	0.9634	0.9393	0.8408	1.3295	1.0406	1.3945	1.2400
PETKM	0.8395	0.8241	0.8351	0.8077	0.8077	0.6143	0.5260	0.6788	0.6335
TOASO	0.8844	0.8491	0.8831	0.8642	0.7824	1.1894	0.9517	1.2478	1.0639
TTRAK	0.9202	0.8676	0.9000	0.8817	0.8640	0.8431	0.6815	0.8551	0.8434
VESTL	0.4369	0.4161	0.4731	0.3961	0.3653	0.5261	0.4209	0.5566	0.5392

Afterwards, the summation of absolute deviations was computed by Eq. (8), and shown in Table 12.

Table 12. The sums of absolute deviations (E_j)

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9
E_j	1.1906	1.1366	1.1946	1.1408	1.7817	1.7420	1.4927	1.9968	1.7051

According to Eq. (9), the final weights of criteria were calculated, and its results are shown in Table 13.

Table 13. The results of MEREC method (2018-2022)

MEREC	Year	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9
w_j	2018	0.1127	0.0985	0.1139	0.1312	0.1643	0.0984	0.0907	0.0849	0.1055
Ranking		4	6	3	2	1	7	8	9	5
w_j	2019	0.0951	0.1034	0.0966	0.1146	0.0900	0.1071	0.0721	0.1840	0.1371
Ranking		7	5	6	3	8	4	9	1	2
w_j	2020	0.1302	0.1428	0.1136	0.1386	0.1773	0.0914	0.0711	0.0585	0.0766
Ranking		4	2	5	3	1	6	8	9	7
w_j	2021	0.0938	0.1134	0.0895	0.0978	0.1735	0.1056	0.0923	0.1318	0.1023
Ranking		7	3	9	6	1	4	8	2	5
w_j	2022	0.0890	0.0849	0.0893	0.0853	0.1331	0.1302	0.1116	0.1492	0.1274
Ranking		7	9	6	8	2	3	5	1	4
w_j	Overall	0.1042	0.1086	0.1006	0.1135	0.1476	0.1065	0.0876	0.1217	0.1098
Ranking		7	5	8	3	1	6	9	2	4

The results of the MEREC showed that stock return (C_8), EBITDA (C_5) and net profit margin (C_6) were the most important criteria, while return on equity (C_7), current ratio (C_3) and acid-test ratio (C_1) were the least important criteria in 2022, respectively. Besides, the values of the criteria vary from

year to year. Thus, it can be concluded that the importance of the criteria changes over the years. Therefore, the overall ranking was obtained by taking the average of 5 years.

4.3. The results obtained from the AWM

Eq. (10) was used to calculate the aggregated weight of each criterion, and its results are shown in Table 14.

Table 14. The final values and the rankings

Methods	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9
LBWA									
w_j	0.0779	0.0743	0.1487	0.1363	0.1636	0.1090	0.1168	0.1022	0.0711
Ranking	7	8	2	3	1	5	4	6	9
MEREC									
w_j	0.1042	0.1086	0.1006	0.1135	0.1476	0.1065	0.0876	0.1217	0.1098
Ranking	7	5	8	3	1	6	9	2	4
AWM									
w_j	0.0911	0.0915	0.1247	0.1249	0.1556	0.1078	0.1022	0.1120	0.0905
Ranking	8	7	3	2	1	5	6	4	9

According to results obtained from the AWM, EBITDA (C_5), debt ratio (C_4) and current ratio (C_3) were determined as the most important criteria, while stock turnover (C_9), acid-test ratio (C_1) and asset turnover (C_2) were determined as the least important criteria, respectively.

4.4. The results obtained by the CRADIS Method

After the criterion weights were computed, the financial performance of companies was ranked using the CRADIS method. At first, the decision matrix was formed (Table 15). Afterwards, the decision matrix was normalized using Eqs. (11-12), and shown in Table 16.

Table 15. Decision Matrix

Optimization	max	max	max	min	max	max	max	max	max
Alternatives/ Criteria	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9
ARCLK	0.7642	2.4081	1.1766	75.0285	16,220,288,000.00	2.4441	17.4179	1.4745	5.6053
CIMSA	0.9415	2.0988	1.1899	47.3336	1,235,841,355.00	39.9857	83.5969	2.3003	5.9572
ENJSA	0.6514	4.8553	0.7036	63.5534	8,662,705,000.00	17.1679	93.7682	2.5749	51.8715
ENKAI	2.0627	0.9212	2.3863	23.7059	13,986,197,000.00	3.1734	1.8680	1.5359	8.2590
EREGL	0.9045	1.7463	2.2462	32.1518	26,654,507,000.00	14.0903	18.1926	2.4214	2.2437
FROTO	0.8135	5.1969	1.1984	70.6600	31,981,409,000.00	8.5969	90.4873	2.5696	19.3125
PETKM	0.9324	1.8101	1.1028	65.1331	3,390,088,000.00	13.4570	41.4542	2.7091	8.9823
TOASO	1.1535	3.4755	1.2835	64.9737	18,115,118,000.00	7.5585	59.3435	2.3524	25.4202
TTRAK	0.7543	3.3943	1.2806	64.4528	4,913,650,794.00	10.4108	76.3109	5.2296	9.5145
VESTL	0.3409	2.3436	0.6156	79.0145	6,183,352,000.00	1.4677	8.0029	1.8323	3.2967
max	2.0627	5.1969	2.3863	79.0145	31,981,409,000.00	39.9857	93.7682	5.2296	51.8715
min	0.3409	0.9212	0.6156	23.7059	1,235,841,355.00	1.4677	1.8680	1.4745	2.2437

Table 16. Normalized decision matrix

Alternatives/ Criteria	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9
ARCLK	0.3705	0.4634	0.4931	0.3160	0.5072	0.0611	0.1858	0.2819	0.1081
CIMSA	0.4564	0.4039	0.4986	0.5008	0.0386	1.0000	0.8915	0.4399	0.1148
ENJSA	0.3158	0.9343	0.2949	0.3730	0.2709	0.4294	1.0000	0.4924	1.0000
ENKAI	1.0000	0.1773	1.0000	1.0000	0.4373	0.0794	0.0199	0.2937	0.1592
EREGL	0.4385	0.3360	0.9413	0.7373	0.8334	0.3524	0.1940	0.4630	0.0433
FROTO	0.3944	1.0000	0.5022	0.3355	1.0000	0.2150	0.9650	0.4914	0.3723
PETKM	0.4520	0.3483	0.4621	0.3640	0.1060	0.3365	0.4421	0.5180	0.1732
TOASO	0.5592	0.6688	0.5379	0.3649	0.5664	0.1890	0.6329	0.4498	0.4901
TTRAK	0.3657	0.6532	0.5366	0.3678	0.1536	0.2604	0.8138	1.0000	0.1834
VESTL	0.1653	0.4510	0.2580	0.3000	0.1933	0.0367	0.0853	0.3504	0.0636

After the normalized decision matrix was formed, the weighted normalized decision matrix was computed by Eq. (13), and its results are shown in Table 17.

Table 17. Weighted normalized decision matrix

Alternatives/ Criteria	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9
ARCLK	0.0338	0.0424	0.0615	0.0395	0.0633	0.0095	0.0200	0.0288	0.0098
CIMSA	0.0416	0.0370	0.0622	0.0626	0.0048	0.1556	0.0961	0.0450	0.0104
ENJSA	0.0288	0.0855	0.0368	0.0466	0.0338	0.0668	0.1078	0.0503	0.0905
ENKAI	0.0911	0.0162	0.1247	0.1249	0.0546	0.0123	0.0021	0.0300	0.0144
EREGL	0.0399	0.0307	0.1174	0.0921	0.1041	0.0548	0.0209	0.0473	0.0039
FROTO	0.0359	0.0915	0.0626	0.0419	0.1249	0.0335	0.1040	0.0502	0.0337
PETKM	0.0412	0.0319	0.0576	0.0455	0.0132	0.0524	0.0477	0.0529	0.0157
TOASO	0.0509	0.0612	0.0671	0.0456	0.0707	0.0294	0.0682	0.0460	0.0444
TTRAK	0.0333	0.0598	0.0669	0.0459	0.0192	0.0405	0.0877	0.1022	0.0166
VESTL	0.0151	0.0413	0.0322	0.0375	0.0241	0.0057	0.0092	0.0358	0.0058
max	0.1556								
min	0.002148								

According to Eqs. (14-15), the ideal and anti-ideal solution was determined, and shown in Table 18 and 19, respectively.

Table 18. Ideal solution

Alternatives/ Criteria	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9
ARCLK	0.1218	0.1132	0.0941	0.1161	0.0923	0.1461	0.1356	0.1268	0.1458
CIMSA	0.1140	0.1186	0.0934	0.0930	0.1508	0.0000	0.0595	0.1106	0.1452
ENJSA	0.1268	0.0701	0.1188	0.1090	0.1218	0.0888	0.0478	0.1053	0.0651
ENKAI	0.0645	0.1394	0.0309	0.0307	0.1010	0.1433	0.1535	0.1256	0.1412
EREGL	0.1157	0.1249	0.0382	0.0635	0.0515	0.1008	0.1347	0.1083	0.1517
FROTO	0.1197	0.0641	0.0930	0.1137	0.0307	0.1221	0.0516	0.1054	0.1219
PETKM	0.1144	0.1237	0.0980	0.1101	0.1424	0.1032	0.1079	0.1027	0.1399
TOASO	0.1047	0.0944	0.0885	0.1100	0.0849	0.1262	0.0874	0.1096	0.1112
TTRAK	0.1223	0.0958	0.0887	0.1097	0.1364	0.1151	0.0679	0.0534	0.1390
VESTL	0.1405	0.1143	0.1234	0.1181	0.1315	0.1499	0.1464	0.1198	0.1498
min	0.0645	0.0641	0.0309	0.0307	0.0307	0	0.0478	0.0534	0.0651

Table 19. Anti-Ideal solution

Alternatives/ Criteria	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9
ARCLK	-0.0316	-0.0403	-0.0593	-0.0373	-0.0612	-0.0074	-0.0179	-0.0267	-0.0076
CIMSA	-0.0394	-0.0348	-0.0600	-0.0604	-0.0027	-0.1535	-0.0940	-0.0428	-0.0082
ENJSA	-0.0266	-0.0833	-0.0346	-0.0444	-0.0317	-0.0647	-0.1057	-0.0482	-0.0884
ENKAI	-0.0890	-0.0141	-0.1226	-0.1228	-0.0525	-0.0102	0.0000	-0.0279	-0.0123
EREGL	-0.0378	-0.0286	-0.1152	-0.0899	-0.1019	-0.0527	-0.0188	-0.0452	-0.0018
FROTO	-0.0338	-0.0894	-0.0605	-0.0398	-0.1228	-0.0313	-0.1019	-0.0481	-0.0315
PETKM	-0.0390	-0.0297	-0.0555	-0.0433	-0.0111	-0.0502	-0.0455	-0.0508	-0.0135
TOASO	-0.0488	-0.0590	-0.0649	-0.0434	-0.0686	-0.0273	-0.0661	-0.0438	-0.0422
TTRAK	-0.0312	-0.0576	-0.0648	-0.0438	-0.0170	-0.0384	-0.0856	-0.1001	-0.0145
VESTL	-0.0129	-0.0391	-0.0300	-0.0353	-0.0220	-0.0036	-0.0071	-0.0337	-0.0036
max	-0.0129	-0.0141	-0.0300	-0.0353	-0.0027	-0.0036	0.0000	-0.0267	-0.0018

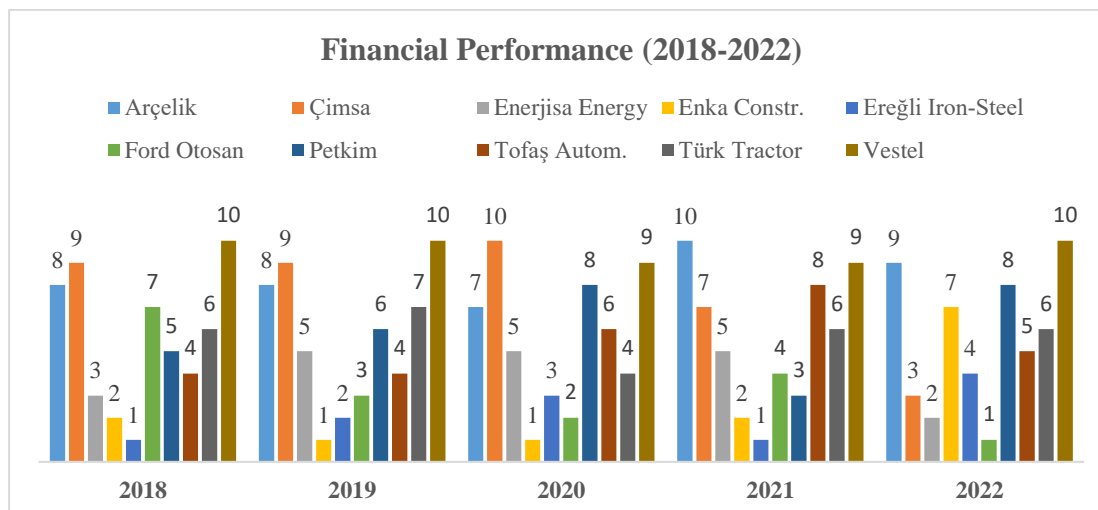
Eqs. (18-19) were used to determine the grades of the deviation of individual alternatives from ideal and anti-ideal solutions. Then, Eqs. (20-21) were applied to calculate the utility function for each alternative. Afterwards, Eq. (22) was used to obtain the final values of alternatives. Table 20 illustrates the results of CRADIS method.

Table 20. The final values and rankings of CRADIS

Alternatives	s_i^+	K_i^+	s_i^-	K_i^-	Q_i	Rank
ARCLK	1.0918	0.3546	-0.2892	2.2775	1.3161	9
CIMSA	0.8853	0.4374	-0.4958	3.9041	2.1707	3
ENJSA	0.8535	0.4536	-0.5275	4.1538	2.3037	2
ENKAI	0.9299	0.4164	-0.4511	3.5522	1.9843	7
EREGL	0.8892	0.4355	-0.4919	3.8732	2.1544	4
FROTO	0.8222	0.4710	-0.5589	4.4009	2.4359	1
PETKM	1.0424	0.3715	-0.3387	2.6668	1.5191	8
TOASO	0.9169	0.4223	-0.4642	3.6547	2.0385	5
TTRAK	0.9282	0.4171	-0.4528	3.5656	1.9914	6
VESTL	1.1938	0.3243	-0.1873	1.4744	0.8994	10
S_o	0.3872		-0.1270			

According to results obtained from the CRADIS method showed that Ford Otosan, Enerjisa and Çimsa were identified as companies with the highest financial performance in 2022. Conversely, Vestel, Arçelik and Petkim were identified as companies with the lowest financial performance in 2022. Additionally, the financial performance of companies between 2018 and 2022 is presented in Figure 1.

Figure 1. Financial performance of companies by years



It can be seen above, Ereğli Iron-Steel, Enka construction and Ford Otosan were identified as companies with the highest financial performance, while Vestel, Arçelik and Çimsa were identified as companies with the lowest financial performance in the period of 2018 and 2022. Stanujkić et al. (2013) and Aydın and Gümüş (2022) pointed out that a comparative analysis is necessary to better understand similarities and differences among MCDM methods. Moreover, decision-makers can confirm the robustness and validity of the results obtained from the proposed model using a comparative analysis. Therefore, the proposed model is tested with nine different MCDM methods.

4.5. Sensitivity and Comparative Analysis

As mentioned above, sensitive and comparative analysis are crucial to validate and strengthen the results obtained from the proposed model. Firstly, sensitivity analysis was conducted by changing the value of elasticity coefficient (r_0). Then, comparative analysis was carried out using different MCDM methods, namely, ARAS, COPRAS, EDAS, MABAC, MAIRCA, MARCOS, TOPSIS, CoCoSo and MAUT. Figure 2 and 3 illustrates the sensitivity and comparative results, respectively.

Figure 2. Comparative analysis

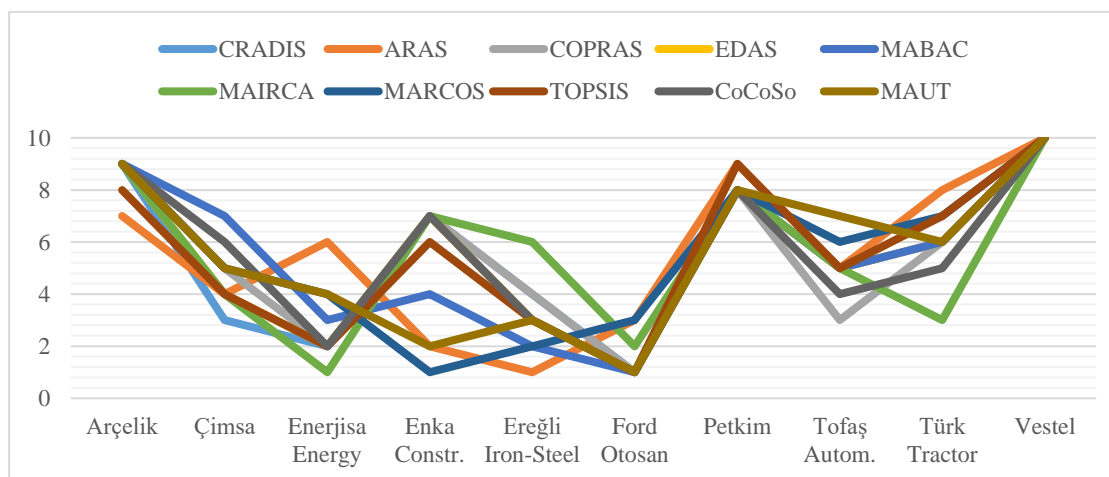
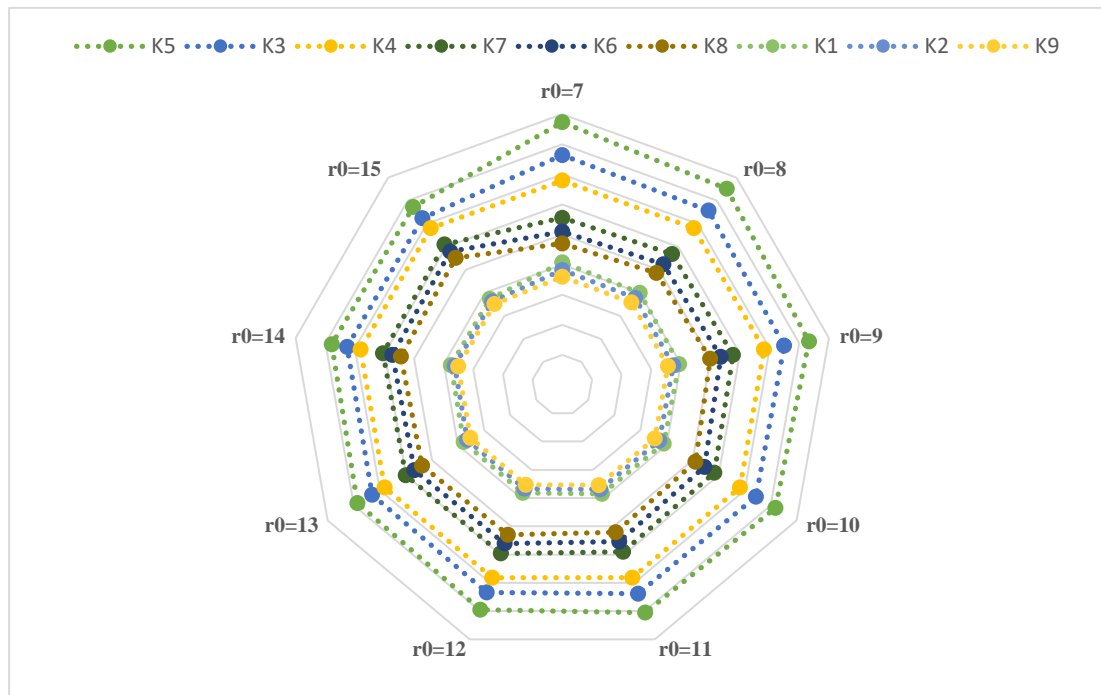


Figure 3. Sensitivity analysis



From the above can be observed that the changes in the elasticity coefficient caused minor changes in the weight coefficients of criteria. Nevertheless, it can be noted that the ranking of the criteria remained constant. Moreover, it can be observed that the company with the highest financial performance according to the CRADIS method aligns exactly with the rankings from the COPRAS, EDAS, MABAC, TOPSIS, CoCoSo, and MAUT methods. Additionally, the results indicate that the rankings derived from the CRADIS method do not differ significantly from those obtained from the other methods. Consequently, it can be inferred that the results of the LBWA and MEREC-based CRADIS methods are consistent with those of other methods. Table 21 demonstrates overall results based on different MCDM methods.

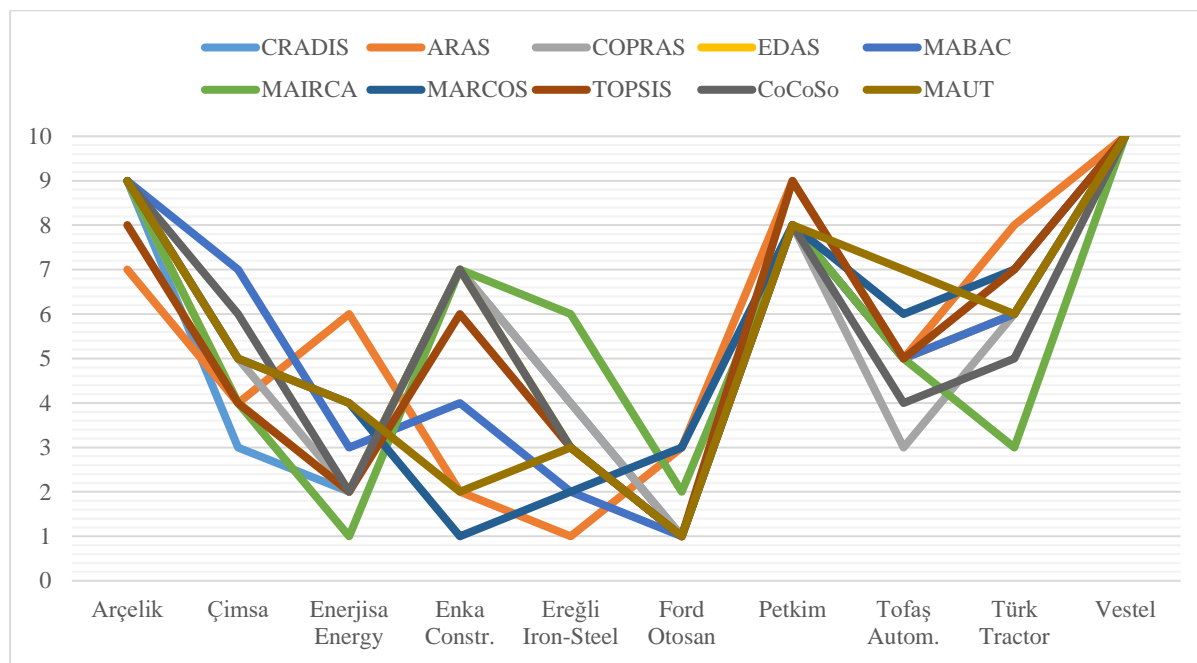
Table 21. Rankings obtained from different MCDM methods

Alternatives/ Methods	CRADIS	ARAS	COPRAS	EDAS	MABAC	MAIRCA	MARCOS	TOPSIS	CoCoSo	MAUT
ARCLK	9	7	9	9	9	9	9	8	9	9
CIMSA	3	4	5	4	7	4	5	4	6	5
ENJSA	2	6	2	2	3	1	4	2	2	4
ENKAI	7	2	7	7	4	7	1	6	7	2
EREGL	4	1	4	3	2	6	2	3	3	3
FROTO	1	3	1	1	1	2	3	1	1	1
PETKM	8	9	8	8	8	8	8	9	8	8
TOASO	5	5	3	5	5	5	6	5	4	7
TTRAK	6	8	6	6	6	3	7	7	5	6
VESTL	10	10	10	10	10	10	10	10	10	10

It can be observed that the company with the highest financial performance according to the CRADIS method aligns exactly with the rankings from the COPRAS, EDAS, MABAC, TOPSIS, CoCoSo, and

MAUT methods. Additionally, the results indicate that the rankings derived from the CRADIS method do not differ significantly from those obtained from the other methods. Consequently, it can be inferred that the results of the LBWA and MEREC-based CRADIS methods are consistent with those of other methods. Figure 2 illustrates the comparative results obtained from the different MCDM methods.

Figure 4. Comparison of the rankings



5. DISCUSSION AND CONCLUSION

Financial performance plays a crucial role analyzing a company's current financial situation and potential growth. The evaluation of financial performance is widely regarded as a critical priority in all economic decision-making processes concerning both public and private enterprises (Chashmi & Fadaee, 2016). Financial performance measurement is affected by various indicators, including asset turnover, current ratio, net profit margin, return on equity, stock turnover and many other financial ratios. Additionally, determining the most appropriate indicators for measuring a company's financial performance is very important for decision-makers such as investors, managers, policy-makers and banks. While there are numerous indicators for assessing financial performance, the selection of suitable ratios depends on the characteristics of the study. Previous studies shown that some financial indicators such as liquidity ratios, leverage ratios, profitability ratios, stock ratios are widely used to evaluate the financial performance of companies (Baydaş & Pamučar, 2022; Doğan & Karaçayır, 2023; Kaya et al., 2024). Correspondingly, this study aimed to obtain more comprehensive and reliable results for companies in the BIST Sustainability 25 index using the most frequently used financial indicators and MCDM methods in the literature.

The present study was designed to determine the weight of criteria based on two different approaches including both objective and subjective methods. The MEREC results showed that the

importance level of criteria varied from year to year. For example, while EBITDA was in the top three-ranked in 2018, 2020, 2021 and 2022, it was at the bottom-ranked in 2019. Stock return was in the top three-ranked in 2019, 2021 and 2022, it was in the last-ranked in 2018 and 2020. Hence, it can be observed that there were significant differences in the ranking of criteria over the years. Odu (2019) stated that weights of criteria can significantly influence the outcome of the decision-making process, so it is important to pay particular attention to the determination of criteria weights. Therefore, in this study, the overall ranking result was obtained by taking the average of 5 years. Additionally, the most interesting finding was that EBITDA was the most important criterion in both methods. This finding suggests that EBITDA holds significance as one of the primary financial indicators, both in mathematical equations and according to expert opinions. The findings of the current study similar from the findings of similar research in the literature. For instance, Moghimi and Anvari (2014) found that the current ratio is the most important criteria for evaluation the financial performance of Iranian cement companies. Abdel-Basset et al. (2020) pointed out that the debt ratio and current ratio are considered as key indicators for financial performance measurement. Moreover, Ersoy (2023) found that the current ratio is the most important criterion in certain years. Kaya et al. (2024) discovered that EBITDA and the current ratio are the most important criteria in the BIST Sustainability Index companies. Nevertheless, it is feasible to encounter studies in the literature that yield different results (Ayçin & Güçlü, 2020; Yıldırım & Meydan, 2021; Pala, 2022). Consequently, the findings from this study, as well as prior research, have indicated that the most or least significant indicators influencing financial performance can vary depending on factors such as years, sectors, methodologies, and financial ratios. According to results obtained by the CRADIS method, Ereğli Iron-Steel, Enka construction and Ford Otosan were the companies with the highest financial performance, while Vestel, Arçelik and Çimsa were the companies with the lowest financial performance between 2018 and 2022. When comparing the ranking results obtained from this study with those from previous studies, it is important to take sectoral differences into account. Therefore, the ranking results were analyzed separately for each industry. The present findings seem to be consistent with another research. For instance, Onder and Altıntaş (2017) and Sahin and Karacan (2019) found that Enka was one of the companies with the best financial performance among the construction firms. Furthermore, Uğuz Arsu and Arsu (2023) found that Ford Otosan was one of the companies with the best financial performance among manufacturing companies. Moreover, Arsu (2021) found that Enerjisa was one of the companies with the best financial performance among Electricity, Gas and Steam Sector. Based on these, it can be concluded that companies with high financial performance in the Sustainability 25 Index also show the same performance in their own indexes. Another notable finding from this study is that the financial performance of companies appears to be quite consistent by different MCDM methods. For instance, companies with the highest financial performance across seven MCDM methods, namely, CRADIS, COPRAS, EDAS, MABAC, TOPSIS, CoCoSo and MAUT remained constant. Additionally, it was found that the companies with the lowest financial performance are similar for all methods. The present findings seem to be consistent with other

research which found that the best alternative is the same for all methods. For instance, Özdağoğlu et al. (2021) pointed out that the best alternative is constant for all methods (MOPA, MOOSRA, COPRAS, SAW and WPM) except ROV method. Furthermore, Özbek and Özekenci (2023) found that countries with the highest logistics market performance is similar for all methods (MAUT, TOPSIS, MARCOS, CoCoSo and BORDA). Additionally, Aydin and Gümüş (2024) found that the optimal alternative is the same for all methods (AHP-VIKOR-WASPAS-PROMETHEE 2-GRA-ARAS-COPRAS and BORDA) except TOPSIS, GTMA and MULTIMOORA. Some managerial implications have been suggested for the relevant field based on the findings obtained from this study. Firstly, decision-makers should prioritize strategies aimed at enhancing EBITDA, as it is a crucial measure of cash flow generation and operational performance. Secondly, managers need to carefully oversee working capital elements like inventory levels, accounts receivable and accounts payable to enhance the current ratio. Thirdly, managing the debt ratio effectively is crucial for maintaining financial stability and minimizing financial risk. Thus, managers should analyze the most suitable capital structure considering the firm's risk tolerance and industry dynamics. Overall, the current paper will provide valuable insights to decision-makers in this field, aiding them in forming more comprehensive conclusions regarding the financial performance of companies. Nevertheless, it is important to acknowledge several limitations of this study. Firstly, the study was conducted within the scope of only 10 companies, based on the availability of data from the BIST Sustainability 25 Index. While these companies provide valuable insights, the limited sample size may not fully capture the diversity of the broader market. Therefore, future studies could address this limitation by expanding the number of companies. Secondly, the study's scope is confined to companies listed in the sustainability index of the BIST, which cannot represent the full spectrum of companies operating in other countries. To enhance the generalizability of findings and facilitate cross-country comparisons, future research could incorporate companies included in sustainability index from different countries. Thirdly, although the current study utilized a wide range of MCDM methods, future studies might apply additional MCDM techniques, including fuzzy logic and gray approaches, to provide a more comprehensive understanding of the financial performance.

The study does not necessitate Ethics Committee permission.

The study has been crafted in adherence to the principles of research and publication ethics.

The author declares that there exists no financial conflict of interest involving any institution, organization, or individual(s) associated with the article.

The entire work was carried out by its only, stated author.

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Relationship Between Financial Development and Carbon Emissions: Empirical Evidence from Türkiye with Fractional Frequency Fourier Approaches

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Abstract

This study empirically analyzes the relationship between carbon emissions, one of the most important indicators of environmental pollution, and financial development. Using data from Türkiye for the period 1995-2019, the fractional frequency Fourier ADL cointegration method -previously unused in similar studies- is employed for the analysis. The results, which also account for economic growth, demonstrate a cointegration relationship between the variables. Additionally, the FMOLS method is utilized for model estimation, concluding that financial development and growth lead to increased carbon emissions. The study suggests that loans provided to the financial sector should be directed towards technological investments that reduce carbon emissions

Keywords: *Carbon Emissions, Financial Development, Fractional Frequency Fourier Cointegration.*

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1. INTRODUCTION

Climate change is one of humanity's most important challenges in the 21st century. Climate change is seriously affecting both nature and people, especially with the melting of glaciers and rising sea levels. Climate change, defined as the unexpected changes in the climate, occurs because of rising average temperatures, in other words, global warming. Climate scientists point to the "greenhouse effect" as the main cause of global warming (Ozturk & Acaravci, 2010). This is because greenhouse gas increases exacerbate the natural greenhouse effect by increasing the gas density in the atmosphere, which leads to a gradual increase in the earth's temperature (Bilgili et al., 2016; Koçak, 2017).

Given the importance of environmental protection, the United Nations Framework Convention on Climate Change is considered an important development (Say & Yucel, 2006). The first significant step of the Convention was the Kyoto Protocol, which entered into force in 2005. This protocol, which imposes binding obligations on developed countries to reduce greenhouse gas emissions, did not become a global agreement. The reason behind this is that the world's largest emitters, such as India, Canada, and the USA, did not ratify the protocol. The Paris Agreement was signed in 2015 under the United Nations Framework Convention on Climate Change (Alam et al., 2012). The main objective of both the Kyoto Protocol and the Paris Agreement is to reduce greenhouse gas emissions. These global steps highlight the universal importance of reducing greenhouse gas emissions and, more broadly, environmental degradation.

The relationship between economic development and environmental degradation has an inverted U shape, as emphasized by Grossman and Krueger (1991). Accordingly, although environmental degradation increases in the initial period of economic growth, it decreases after a certain threshold. In addition to economic growth, financial development is an important factor in reducing greenhouse gases. According to Tamazian et al. (2009), financial development is a key explanatory variable in understanding the link between economic growth and the environment. The financial sector increases technological development in the energy field, affecting greenhouse gas emissions and energy consumption (Yang et al., 2015).

The theoretical expectation for the effects of financial development, which is one of the determining factors influencing carbon emissions, is not unidirectional. While financial development encourages investment in clean energy projects by lowering financing costs, it also negatively affects environmental quality by encouraging industrialization and energy consumption. Therefore, the relationship between financial development and carbon emissions has become an important issue that needs to be examined in various dimensions.

Given the issue's importance, the main objective of this study is to empirically examine the relationship between carbon emissions and financial development. There are a significant number of studies on the subject in the literature. However, this study differs from other studies in the analysis

methods used. Thus, this study can be considered a pioneering work in addressing the subject with a different method. The analysis results are important in terms of contributing to the literature on the subject and guiding future studies.

In this study, firstly, the relationship between carbon emissions and financial development and growth is analyzed theoretically and Türkiye's situation is presented in this context. Then, the empirical literature on the subject is presented. Finally, after introducing the empirical analysis methods, the results of the analysis are interpreted and policy implications are identified.

2. CARBON EMISSIONS, FINANCIAL DEVELOPMENT AND TÜRKİYE

Climate change can be characterized as one of the biggest problems facing humanity in the current century. Increases in greenhouse gases, including burning fossil fuels such as coal, oil, natural gas and large-scale deforestation, cause changes in global temperature and precipitation (Ozturk & Acaravci, 2010). Carbon emissions constitute approximately $\frac{3}{4}$ of greenhouse gas emissions, which are one of the most important causes of climate change and environmental degradation.

Environmental degradation is one of the issues that have come to the forefront in terms of the sustainability of economic growth. The increase in greenhouse gases triggers environmental degradation in both developed and developing countries. In most countries, industrialization based on non-renewable energy consumption leads to increased environmental degradation and affects development in the long run (Solarin, 2019, p. 6167).

Energy and environmental sustainability are crucial for economic growth and social welfare. At this point, policies to increase economic growth should not come at the expense of environmental degradation (Khobai and Sithole, 2022, p. 516). Due to increasing environmental degradation, a large literature has emerged on the relationship between carbon emissions and economic growth. This literature is based on the Environmental Kuznets Curve (EKC) approach. According to this approach, although environmental degradation occurs in the early stages of development, increased economic development after a certain stage reduces carbon emissions (Grossman & Helpman, 1991; Stern, 2004).

The economic growth of countries causes them to use energy intensively. This situation leads to an increase in carbon emissions. On the other hand, economic growth and development trigger the emergence of energy-efficient and low-carbon technologies that replace carbon-intensive technologies. In this context, while the relationship between growth and carbon emissions is positive in the short run, it is negative in the long run. In fact, both GDP per capita and carbon emissions increased in Türkiye in the 1995-2019 period, and this increase has accelerated in the last decade (World Bank, 2023)

Today, the increase in the production of countries, in other words, the increase in income, causes environmental pollution. However, carbon emissions are not a concept that depends only on the income level of countries. Energy consumption, foreign trade (or trade openness), and financial development also affect carbon emissions. At this point, studies on the subject have expanded the factors affecting

carbon emissions from the perspective of issues such as financial development, openness to foreign trade, and trade intensity (Zhang, 2011).

The first empirical studies in the literature on the relationship between financial development and the environment are by Aufderheide and Rich (1988) and Schmidheiny and Zorraquin (1998). In their study, Aufderheide and Rich (1988) pointed out that the World Bank's financial assistance ignored the countries' environmental aspects. Similarly, Schmidheiny and Zorraquin (1998) emphasized in their study that environmental problems are ignored in short-term loans provided by financial institutions.

The impact of financial development on environmental quality can be divided into two groups. The first group focuses on the fact that financial development deteriorates environmental quality. Accordingly, the acceleration of economic financial development triggers investments and development in the industrial sector. This, in turn, leads to accelerated economic development and increased energy demand. Thus, greenhouse gas emissions in countries increase (Sekali & Bouzahzah, 2019). According to Sadorsky (2011), financial development expands credit availability for energy-intensive consumer goods (such as cars and refrigerators), accordingly, energy use and greenhouse gas emissions increase. In addition, financial development can stimulate technological development, leading to an increase in excessive demand for natural resources. This excessive increase, called the rebound effect, accelerates technological developments and increases energy efficiency in all areas of the economy or, in other words, reduces the energy/output ratio (energy intensity). Increasing energy efficiency leads to increased production and energy use (Yuixang & Chen, 2011; Koçak, 2017). Therefore, increasing energy consumption due to the rebound effect increases environmental pollution.

The second group focuses on the positive impact of financial development on environmental quality. In this context, financial development leads to lower financial intermediation costs. In addition, it allows investments to be directed towards clean energy projects with risk diversification (Nasir et al., 2019, p. 132). The reasons why financial development reduces carbon emissions can be summarized as follows (Tamazian, et al., 2009; Dasgupta, et al., 2001; Islam, et al., 2013; Doytch, 2020):

- Updating production technology and equipment is important for enterprises wanting to increase their market competitiveness. In this respect, a well-developed financial system effectively reduces the financing constraints of enterprises and allows them to update their production technology and equipment. This indirectly reduces production costs and carbon emissions.

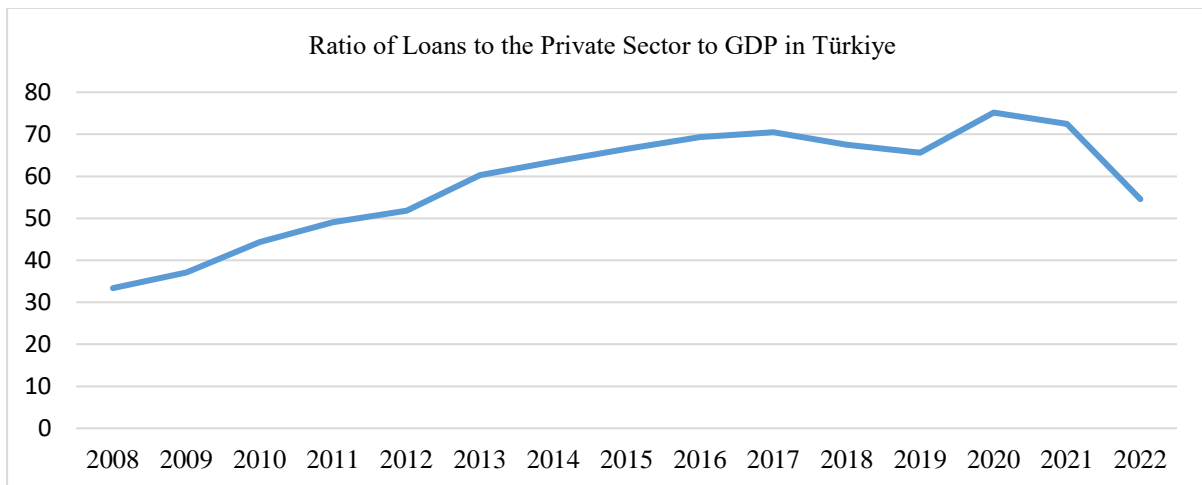
- Financial institutions provide funding for projects that can help improve energy infrastructure and reduce carbon emissions.

- Listed companies have a good image in terms of reducing carbon emissions by using environmentally friendly technologies. It has been demonstrated in some studies (such as Konar and Cohen, 2001) that there is a relationship between the environmental performance of businesses and their stock market values.

• Foreign direct investments, one of the impact channels of financial development on the environment, can improve environmental quality by enabling new knowledge and technological developments despite some negative effects. According to this view, whose theoretical basis is formed by the pollution halo hypothesis, multinational companies from developed countries that generally make these investments apply environmentally protective production methods in the countries where they invest.

Studies focusing on the relationship between carbon emissions and financial development in the literature support the view that financial development has both positive and negative effects. Differences in the country, data range, and methodology affect the different results of the studies. In the literature, various variables such as private sector loans, money supply (M2), fixed capital investments, and loans provided by banks to the private sector are used as indicators of financial development. Figure 1 shows the change in the ratio of loans to the private sector to GDP, which is the most widely used variable among these variables in empirical studies, for the case of Türkiye.

Figure 1. Ratio of Loans to the Private Sector to GDP in Türkiye (2008-2022)

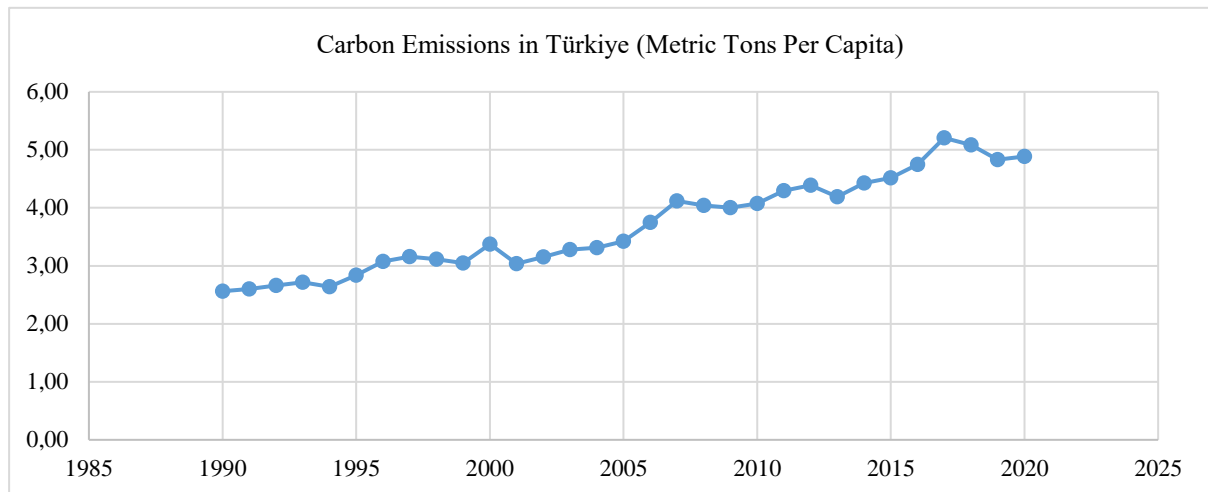


Source: Created with data obtained from the World Bank (2023) database.

Figure 1 shows that loans to the private sector have increased over the years. Although these loans decreased in 2018 and 2019, they increased again in 2020. In 2018 and 2019, the most important reason for the decline in loans to the private sector was the financing crisis. In 2022, there was a decline in these loans again.

As mentioned earlier, greenhouse gas emissions are one of the most important causes of climate change. Carbon emissions constitute a large portion of greenhouse gas emissions. China, the USA, and the EU countries rank first in carbon emissions worldwide, and Türkiye is among the top 20 countries. Figure 2 shows the carbon emissions (metric tons per capita) in Türkiye for the period 1990-2020.

Figure 2. Carbon Emissions in Türkiye (1990-2020)



Source: Created with data obtained from the World Bank (2023) database.

According to Figure 2, although carbon emissions in Türkiye have fluctuated over the years, the general trend has been upward. This increase, which is largely driven by the energy and industrial sectors, has accelerated more in the last decade. The year with the highest carbon emissions was 2017.

3. LITERATURE REVIEW

There is a large literature on environmental pollution and its economic implications. In recent studies, carbon emissions and carbon footprints have been considered important indicators of environmental degradation. Most studies focusing on the relationship between financial development and the environment analyze the growth variable as one of the explanatory variables. At this point, it is important to present the empirical literature review in more detail.

One of the first studies to examine the impact of financial development on carbon emissions is the study by Tamazian et al. (2009). This study on BRIC (Brazil, Russia, India, and China) countries used data from the period 1992-2004 and panel data analysis. As a result of the analysis, it is found that financial development in BRIC countries leads to a decrease in the amount of carbon emissions. Shahbaz, Tiwari & Nasir (2013), and Tang & Tan (2015) also reached the same conclusion. On the other hand, Boutabba (2014), Shahzad et al. (2017), Jiang & Ma (2019), and Rjoub et al. (2021) find that financial development increases the amount of carbon emissions.

When the studies in the existing literature are analyzed, it is evident that a large number of studies examine the relationship between carbon emissions and growth. However, the ARDL method and traditional analysis methods are mostly used in the analysis methods. In this respect, this study is expected to significantly contribute to the literature. This is because, unlike the studies in the literature, this study examines the issue with up-to-date analysis methods.

The literature on the relationship between environmental quality and growth/development is mainly based on the hypothesis that environmental damage starts to decrease as a country develops.

Therefore, the theoretical foundations of the literature focus on the EKC approach. In this approach, the environment-income relationship is expressed in the inverted U-shape proposed by Kuznets. In the literature, the study of Grossman and Kruger (1991) is one of the main studies that empirically reveals the relationship between environment and income. According to Grossman and Kruger (1991), economic growth affects the environment through three channels. These are scale effect, composition effect, and technical effect. Examples of studies examining the impact of growth on carbon emissions include Perman & Stern (2003), Lean & Smyth (2010), Saboori & Sulaiman (2013), Apergis & Ozturk (2015), Khobai & Sithole (2022).

The literature also includes studies examining the impact of growth and financial development on carbon emissions. Table 1 summarizes the studies on the relationship between carbon emissions and these two variables, which are among its important determinants.

Table 1. Studies on the Effects of Growth and Financial Development on Carbon Emissions

Author(s)	Country/Countries	Period	Method	Results
Pao & Tsai (2011)	Brazil, Russia, India, China	1997-2007	OLS	Financial development contributes to the increase in carbon emissions. Moreover, the EKC hypothesis is confirmed.
Jalil & Feridun (2011)	China	1953-2006	ARDL	Financial development reduces carbon emissions. Moreover, the EKC hypothesis is confirmed.
Shahbaz et al. (2012)	Malaysia	1971-2008	ARDL	Financial development reduces carbon emissions.
Shahbaz et al. (2013)	Indonesia	1975 Q1-2011 Q4	VECM	Financial and economic development increase carbon emissions.
Rault (2015)	MENA Countries	1990-2011	Panel Data	It was revealed that the neutrality hypothesis was supported.
Farhani & Ozturk (2015)	Tunisia	1971-2012	ARDL	Financial development contributes to the increase in carbon emissions. Moreover, the EKC hypothesis could not be confirmed.
Li et al. (2015)	102 Countries	1980-2010	GMM	There is an "inverted U-shape" between carbon emissions and growth.
Al-Mulali et al. (2015)	93 Countries	1980-2008	OLS, GMM	Financial development reduces carbon emissions. However, the EKC hypothesis is confirmed for high-income countries.
Seker et al. (2015)	Türkiye	1974-2010	Hatemi-J Cointegration, ARDL	Financial development contributes to the increase in carbon emissions. Moreover, the EKC hypothesis is confirmed.
Ng et al. (2016)	ASEAN Countries	2000-2010	Panel Data	Financial and economic development positively affects carbon emissions.
Dogan & Turkekul (2016)	USA	1960-2010	ARDL	The financial development variable is insignificant. The EKC hypothesis could not be confirmed.
Siddique (2017)	Pakistan	1980-2015	ARDL	Financial development and growth increase carbon emissions.
Cetin et al (2018)	Türkiye	1960-2013	Granger Causality	A long-run causal relationship exists between financial development, growth and carbon emissions.
Temelli & Sahin (2019)	10 Emerging Markets	1995-2014	Durbin-H panel Cointegration, AMG	A significant relationship exists between growth and carbon emissions.
Pala & Barut (2021)	E7 Countries	1990-2014	Panel Data	It is concluded that financial development improves environmental quality in Russia, Indonesia and Türkiye.

Table 1 (cont.)

Author(s)	Country/Countries	Period	Method	Results
Afsar & Yüksel (2022)	Türkiye	1980-2019	NARDL	It is concluded that negative shocks to financial development lead to increased carbon emissions.
Gultekin (2023)	Türkiye	1980-2020	ARDL	Both economic growth and financial development increase carbon emissions.

4. EMPIRICAL ANALYSIS

In this section, information on the data set and the model is provided first. Then, unit root analysis and cointegration analysis is presented respectively. Finally, the estimation results is interpreted statistically and economically.

4.1. Data Set and Model

For the empirical analysis, carbon emissions are modeled as the dependent variable. Data for Türkiye for the period 1995-2019 are used. The data range in the study is created based on the availability of data. In the study, information and communication technologies (ICT) and economic complexity variables are also added to the model as control variables. Therefore, it can be considered that this study is a candidate to be one of the pioneer studies in terms of the model created and the method used. Thanks to the created model, different indicators affecting carbon emissions are analyzed together. Shahbaz et al. (2012), Shahbaz et al. (2013), Akay et al. (2015) and Gökmenoglu and Taspınar (2016) are utilized in the construction of the model. The model created as a result of the existing literature review is as follows:

$$\ln CO2_t = \beta_0 + \beta_1 \ln FD + \beta_2 \ln G + \beta_3 \ln ICT + \beta_4 \ln ECI + \varepsilon_t \quad (1)$$

The symbols and data sources of the variables used in the model are tabulated. Information on the variables is shown in Table 2:

Table 2. Data and Sources

Variables	Symbol	Data Sources
Carbon Emissions (Metric Tons per capita)	CO ₂	World Bank
GDP (Constant 2015 US\$)	G	World Bank
Financial Development Index	FD	International Monetary Fund
Fixed telephone subscriptions (per 100 people)	ICT	World Bank
Economic Complexity Index	ECI	Atlas Database

4.2. Stationarity Analysis

The fractional frequency Fourier ADF unit root test introduced by Bozoklu et al. (2020) is based on the Enders and Lee (2012a) test. While the frequency value takes integer values in the Enders and Lee (2012a) test, it takes fractional values in this test. The proposed model for the unit root test is as follows (Konat et al., 2022, p. 579):

$$\Delta y_t = \delta_1 + \delta_2 t + \delta_3 \sin\left(\frac{2\pi kt}{T}\right) + \delta_4 \cos\left(\frac{2\pi kt}{T}\right) + \rho y_{t-1} + \sum_{i=1}^p \alpha_i \Delta y_{t-1} + e_t \quad (2)$$

As suggested in Christopoulos and Leon-Ledesma (2011) and Omay (2015), the frequency value takes fractional values rather than integer values. The frequency values suggested by Bozoklu et al. (2020) are in the range of [0.1, 0.2, ..., 5]. In the test, nonlinearity is tested as $\delta_3 = \delta_4 = 0$

The prerequisite for the fractional frequency Fourier ADF unit root test is that the trigonometric terms are significant. Otherwise, it would be healthier to prefer the conventional ADF test. While the null hypothesis for the significance of the trigonometric terms emphasizes that the terms are insignificant, the alternative hypothesis emphasizes significance.

The hypotheses for the fractional frequency Fourier ADF unit root test are as follows:

H_0 =Series has unit root.

H_1 =Series are not unit-rooted.

Table 3 presents the fractional frequency Fourier ADF unit root test results for the variables. Accordingly, before determining whether the variables are unit-rooted or not, the significance of the trigonometric terms should be tested. At this point, the calculated value is compared with the table's critical values. If the calculated value is greater than the table's critical values, it is concluded that the trigonometric terms are significant. However, if the calculated test statistic value is not greater than the table value, it is concluded that the series are non-stationary. At the point where the trigonometric terms are insignificant, the results of conventional unit root analysis should be considered.

Table 3. Fractional Frequency Fourier ADF Unit Root Test Results

Variables	Frequency	Min SSR	F Test	Appropriate	FADF Test
CO ₂	0.5	0.531	6.549*	1	-3.461
ΔCO ₂	4.8	0.620	7.318*	5	-3.684***
G	2.8	0.028	6.269	1	0.905
FD	0.8	0.432	4.297	1	-2.885
ICT	0.8	2.955	14.178***	1	-2.870
ΔICT	0.6	3.654	8.838**	1	-4.229**
ECI	0.7	0.080	6.215	2	-3.134

Notes: ***, **, * denote significance levels at 1%, 5% and 10%. For trigonometric terms, we refer to Enders and Lee (2012b). For table values, Bozoklu et al. (2021) are used.

Table 4 presents the results of the conventional ADF unit root test. Accordingly, it is concluded that the variables are not stationary at level but at first difference. At this point, the necessary precondition for cointegration analysis is met.

Table 4. ADF Unit Root Test Results

Variable	Test	Test
CO ₂	-0.811	-4.387***
G	-0.071	-4.350***
FD	-0.622	-7.960***
ECI	-1.016	-5.564***
ICT	-1.096	-2.000

Notes: ***, **, * denote significance levels at 1%, 5% and 10%.

4.3. Cointegration Analysis

The cointegration tests developed by Engle and Granger (1987), Johansen and Juselius (1990), Boswijk (1994), and Banerjee et al. (1998) do not take structural breaks into account. The Fourier ADL cointegration test proposed by Banerjee et al. (2017) considers structural breaks. In this test, dummy variables are used. In addition, smooth structural transitions are considered in the Fourier ADL test.

In their study, Ilkay et al. (2021) use the Fourier ADL cointegration test proposed by Banerjee et al. (2017). At this point, the autoregressive distributed lag model used is as follows:

$$\Delta\gamma_{1t} = d(t) + \delta_1\gamma_{1,t-1} + \gamma'y_{2,t-1} + \mu\Delta y_{2t} + e_t \quad (3)$$

In the above model, Δ denotes the first difference. In the model, γ_{1t} stands for the dependent variable, while δ_1 stands for a scalar. Deterministic terms are expressed as follows:

$$d(t) = \beta_0 + \alpha_1 \sin\left(\frac{2\pi kt}{T}\right) + \alpha_2 \cos\left(\frac{2\pi kt}{T}\right) \quad (4)$$

In the above equation, T: Number of observations, t: Trend term, π : 3.1416, and k: Frequency.

$$\Delta\gamma_{1t} = \beta_0 + \alpha_1 \sin\left(\frac{2\pi kt}{T}\right) + \alpha_2 \cos\left(\frac{2\pi kt}{T}\right) + \delta_1\gamma_{1,t-1} + \gamma'y_{2,t-1} + \mu\Delta y_{2t} + e_t \quad (5)$$

Equation (5) is obtained by substituting equation (4). In their study, Ilkay et al. (2021) estimated equation (3) to determine the optimal value for k.

Banerjee et al. (2017) proposed the Fourier ADL cointegration test. In this study, the frequency value takes values in the range [1, 2, ..., 5]. However, Ilkay et al. (2021) suggest that the frequency value should vary in the range [0.1, 0.2, ..., 5] as emphasized by Christopoulos and Leon-Ledesma (2011). That is, the frequency value takes fractional values instead of integers. Therefore, this method is characterized as the fractional frequency Fourier ADL method.

The hypotheses examining the existence of cointegration are as follows:

H_0 = There is no cointegration relationship.

H_1 = There is a cointegration relationship.

Structural breaks are extremely important in cointegration analyses. Because neglecting structural breaks causes the hypothesis that should be accepted to be rejected or the hypothesis that

should be rejected to be accepted. At this point, it is necessary to know the exact break dates in cointegration tests performed with the help of dummy variables. At this point, Banerjee et al. (2017) proposed the Fourier ADL test to allow for unknown forms of nonlinear breaks. Therefore, the biggest advantage of the test is that it eliminates the problems of cointegration testing performed with the help of dummy variables. In addition, in traditional cointegration tests, failure to reject the basic hypothesis occurs in case of structural break. The results are erroneous in traditional cointegration tests that do not take structural breaks into account.

After concluding that the variables in the model are stationary as of their first difference, cointegration analysis is started. For the integrity of the analysis, the fractional frequency cointegration analysis method is preferred after fractional frequency unit root analysis. Table 5 presents the results of the cointegration analysis. Accordingly, the fractional frequency is determined as 2.6. The fact that the calculated value is greater than the table critical values reveals the existence of a cointegration relationship. In other words, there is a long-run relationship between the variables. Fractional frequency Fourier ADL, Fourier ADL and traditional cointegration tests are comparatively tested and tabulated to analyze the cointegration relationship. Accordingly, while the cointegration relationship is determined according to fractional frequency Fourier ADL and traditional cointegration analysis; according to the Fourier ADL test, no cointegration relationship can be detected. Since the analyses are handled with fractional frequency, it is accepted that there is a cointegration relationship by taking into account the result of the fractional frequency Fourier ADL cointegration test.

Table 5. Fractional Frequency Fourier-ADL Cointegration Analysis Results

Model	$t_{ADL}^F(\hat{k})$	\hat{k}	AIC	Cointegration
CO ₂ = f (FD, G, ICT, ECI)	-4.900**	2.6	-1.875	✓
Fourier ADL Critical Values				
	1%			-5.181
	5%			-4.476
	10%			-4.098

Notes: ***, **, * denote significance levels at 1%, 5% and 10%. Table values are based on Ilkay et al. (2021).

Table 6. Fourier-ADL Cointegration Analysis Results

Model	$t_{ADL}^F(\hat{k})$	\hat{k}	AIC	Cointegration
CO ₂ = f (FD, G, ICT, ECI)	-4.189	4	-1.755	X
Fourier ADL Critical Values				
	1%			-5.427
	5%			-4.703
	10%			-4.329

Notes: ***, **, * denote significance levels at 1%, 5% and 10%. Table values are based on Ilkay et al. (2021).

Table 7. Granger Cointegration Test Results

		Level Values of Residuals (u_t)	
		t-statistics	Probability
ADF test statistics		-3.587	0.014
	% 1	-3.769	
Test Critical Values	% 5	-3.004	
	% 10	-2.642	

4.4. Model Estimation Results

After establishing the existence of a cointegration relationship between the variables, the next step is the model estimation. According to the coefficient estimation results, as seen in Table 8, 9 and 10, GDP, financial development, and ECI positively affect carbon emissions. In other words, increases in GDP, financial development and ECI lead to increases in carbon emissions. The results are theoretically and statistically significant.

Table 8. Estimation of Coefficients (DOLS)

Model		$CO_2 = f(\text{FD}, \text{G}, \text{ICT}, \text{ECI})$		
Variables	Coefficients	Standard Errors	Probability Values	
FD	2.415	1.044	0.033**	
G	1.832	0.748	0.025**	
ICT	-0.027	0.0244	0.271	
ECI	0.847	0.344	0.025**	
C	-0.062	0.042	0.160	
sin	0.109	0.037	0.009***	
cos	0.012	0.042	0.776	

Notes: ***, **, * denote significance levels at 1%, 5% and 10%.

Table 9. Estimation of Coefficients (FMOLS)

Model		$CO_2 = f(\text{FD}, \text{G}, \text{ICT}, \text{ECI})$		
Variables	Coefficients	Standard Errors	Probability Values	
FD	2.741	1.015	0.015**	
G	1.605	0.721	0.040**	
ICT	-0.015	0.025	0.557	
ECI	0.764	0.335	0.036**	
C	-0.051	0.042	0.239	
sin	0.097	0.036	0.016**	
cos	0.012	0.042	0.763	

Notes: ***, **, * denote significance levels at 1%, 5% and 10%.

Table 10. Estimation of Coefficients (CCR)

Model		CO ₂ = f (FD, G, ICT, ECI)		
Variables	Coefficients	Standard Errors	Probability Values	
FD	1.924	1.060	0.088*	
G	1.836	0.760	0.028**	
ICT	-0.035	0.024	0.168	
ECI	0.625	0.349	0.092*	
C	-0.066	0.043	0.146	
sin	0.102	0.038	0.017**	
cos	-0.006	0.043	0.880	

Notes: ***, **, * denote significance levels at 1%, 5% and 10%.

5. CONCLUSION

Environmental pollution has become one of the most important problems in the world today. In addition, countries' environmental policies, energy consumption and renewable and non-renewable energy resources are among the issues that are emphasized. Reducing carbon emissions, which is considered one of the important indicators of environmental pollution, is among the main policy objectives of countries in the long run. In this context, the impact of determinants such as economic growth and financial development on carbon emissions is also one of the important issues empirically analyzed in the literature. Considering the importance of the issue, this study analyzes the impact of financial development on carbon emissions in Türkiye. Unlike other studies, the empirical analyses in this study are carried out with up-to-date analysis methods. Therefore, it is considered that the study contributes to the literature in terms of original value and the methodology used.

The study uses data for the period 1995-2019 to analyze the impact of financial development on carbon emissions. In the empirical analysis, fractional frequency tests are preferred for the sake of methodological integrity for unit root and cointegration analysis. As a result of the analysis, the variables are found to be stationary at first difference. In this case, the next step is the cointegration analysis. The cointegration relationship is comparatively tested and tabulated according to fractional frequency Fourier ADL, Fourier ADL and traditional cointegration tests. Accordingly, while the cointegration relationship is determined according to fractional frequency Fourier ADL and traditional cointegration analysis; according to the Fourier ADL test, no cointegration relationship can be detected. Since the analyses are handled with fractional frequency, it is accepted that there is a cointegration relationship by taking into account the result of the fractional frequency Fourier ADL cointegration test.

As a result of the cointegration analysis, the existence of a cointegration relationship between the variables is determined. Finally, according to the FMOLS, DOLS and CCR estimation results, financial development, GDP and economic complexity variables are found to be statistically significant. Theoretically, a direct relationship exists between financial development, growth and carbon emissions. In other words, financial development and growth are found to increase carbon emissions. In this

context, the results of the analysis support most of the studies in the literature. Some of these studies are as follows: Shahbaz et al. (2013), Ng et al. (2016), Siddique (2017) and Gultekin (2023).

The the study's results reveal the importance of the use of loans provided to the financial sector for the purchase of machinery and equipment that lead to the reduction of carbon emissions. Therefore, policymakers should consider financial factors when formulating policies to reduce carbon emissions, and in this context, they should support lending policies with favorable conditions. Similarly, necessary policy steps should be taken to provide funds to encourage investments in renewable energy and energy efficiency. In this context, the green certificate application, which is also available in countries such as China, Sweden and Australia, can be implemented. The sale of this certificate given to the renewable energy investor for each unit of electricity produced provides additional income depending on the price. The most important advantage of this system is that the policy target for renewable energy can be achieved at a very low cost. In addition, funds such as the Renewable Energy Fund can be established, which is implemented in some countries and is based on the creation of a fund from the fees received from other activities, especially for installing renewable energy production facilities such as solar energy systems. Although the fund has risks such as using its resources in areas other than its intended purpose and mismanagement, it may be possible to eliminate or minimize such risks through practices such as requesting performance documents from companies and providing financing to projects whose feasibility is deemed rational (Akdag & Gozen, 2020)

Development pressures in developing countries do not allow for the development of energy-saving technologies. In these countries, the preference is for expanding the scale of production with credit facilities, which in the long run leads to an increase in the cost of environmental pollution. At this point, governments must provide the necessary financial resources for industrial transformation. In Türkiye, energy consumption is largely based on non-renewable and inefficient energy sources. This leads to significant increases in greenhouse gas emissions. With the right policies to be implemented, industries should be directed towards renewable energy consumption.

This study makes an important contribution to the literature regarding methodological differences. However, the literature can be expanded with empirical studies using different variables representing environmental quality. In this context, future studies can be developed for countries at different income levels by using alternative analysis methods and alternative variables.

The study does not necessitate Ethics Committee permission.

The study has been crafted in adherence to the principles of research and publication ethics.

The authors declare that there exists no financial conflict of interest involving any institution, organization, or individual(s) associated with the article. Furthermore, there are no conflicts of interest among the authors themselves.

The authors contributed equally to the entire process of the research.

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Nonlinearities in Economic Globalization Effects on the Environment: New Insights from a Panel Smooth Transition Regression Model *

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Abstract

This study aimed to estimate the impact of economic globalization on environmental quality and examine the role of renewable energy production (REP) in this impact. For this purpose, the annual data of 1976–2021, which is the longest possible period, of the top 5 countries (Sweden, Switzerland, Norway, France, and Denmark) that show the best performance according to the Global Green Economy Index 2022 report, were used. These countries were chosen due to their high performance in green economy integration; and thus, it was considered that this research could provide reference results for other countries. In order to achieve this, the panel smooth transition regression model was applied to the dataset. This nonlinear approach divides the series into homogeneous regimes depending on the threshold variable and allows us to make regime-specific interpretations. As a result, this study, in which REP was defined as the threshold variable, has shown that there is a two-regime nonlinear relationship between environmental quality and economic globalization. According to the findings, economic globalization caused an increase in environmental degradation in the first regime, which had low REP. However, this impact was eliminated in the second regime, where REP was high.

Keywords: *Renewable Energy Production, Ecological Footprint, Globalization, Panel Smooth Transition Regression Model, Threshold Values.*

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1. INTRODUCTION

The notion of globalization is the result of the industrial development, technological progress, political transformations, and cultural changes of the modern world. While industrialization and technological progress have formed the basis for the economic interaction of countries, they have also resulted in a process of international dependency. This process affects social and political areas as well as economic areas. In this respect, the effects of globalization on the environment are one of the important points to be emphasized in the fight against climate change. Processes such as increasing foreign trade (import and export), foreign direct investments, and the development of tourism within the context of globalization have the potential to affect the ecosystems of the planet we live on as well as the economies of countries.

The world economy is becoming increasingly integrated. According to the World Trade Organization, world trade increased by 45 times from 1950 to 2022. There is a common view that it is not a coincidence that environmental problems are becoming more serious today at the same time as the increase in the pace of economic globalization. This view assumes that trade leads to economic growth, and growth leads to environmental degradation, so trade is bad for the environment (Copeland, 2009). It is also commonly thought that economic globalization is a force that pressures environmental regulation. However, this argument misses the fact that environmental quality is not the only goal for societies. People in the modern world are concerned about their income levels as much as the quality of the environment they live in, and trade is an important factor in promoting economic growth. If policymakers implement measures that could prevent economic growth based on environmental concerns, the economy would shrink. In this case, the concern for environmental quality would lose its priority. Therefore, balancing these two targets against each other is quite important (Frankel, 2003). This has caused much debate in policy circles and encouraged a high number of academic research studies. Following this motivation, this study investigated the impact of economic globalization on the environment and the role of renewable energy production (REP) in this impact.

To contribute to the literature, the top five countries with the best performance according to the Global Green Economy Index (GGEI) 2022 Report were analyzed. Thus, it is thought that the results to be obtained could be a reference for other countries. In addition, the panel smooth transition regression (PSTR) model allowed us to make regime-specific interpretations by separating the series into regimes depending on the threshold variable. Knowing this threshold value that separates regimes from each other would be a guide for developing preventive or incentive policies for countries that have not yet reached the threshold.

The structure of the paper was organized as follows: Section 2 provides the relevant literature, detailed information on the dataset and methodology is given in Section 3, empirical findings are presented in Section 4, and Section 5 contains the conclusions.

2. LITERATURE REVIEW

As a result of studies revealing the economic benefits of globalization, its effects on the environment have also become a subject of interest for researchers. In the last decade, the number of studies examining the relationship between the globalization and environmental performance has been increasing and expanding the related literature. Some of these studies have argued that globalization is beneficial for environmental protection (Leitão, 2014; Shahbaz et al., 2016; Shahbaz et al., 2020; Wang et al., 2021; Çetin et al., 2023), while others, on the contrary, claim that it causes environmental degradation (Leitão, 2013; Leitão & Shahbaz, 2013; Shahbaz et al., 2017; Sharif et al., 2019; Sultana et al., 2023). Among these studies, Leitão (2013) was the first to consider the globalization index as an explanatory variable. In a study covering the period between 1980–2010, the effects of economic growth, energy consumption, and the globalization index on carbon dioxide (CO₂) emissions were examined for Portugal, Spain, Greece, and Ireland. The empirical findings of the study emphasized that globalization intensively increases production by using local resources efficiently, thus increasing CO₂ emissions. However, as the literature expanded, more complex dynamics emerged. For instance, Pata (2021) analyzed the relationship between globalization and environmental pollution for Brazil, Russia, India, and China, (BRIC) spanning from 1971 to 2016, including renewable energy production. As a result, he emphasized that globalization has a negative impact on environmental performance in some countries but that this impact can be eliminated by renewable energy production. On the other hand, Ehigiamusoe et al. (2023) studied the interaction between globalization and tourism. In their research consisting of data for 31 selected African countries from 1995 to 2019, they applied a number of panel data tests to measure the impact of this interaction on CO₂ emissions. Contrary to Pata (2021), their empirical findings suggested that globalization reduces emissions.

As the relevant literature has expanded, the effects of globalization on the environment, taking into account its economic, social, and political dimensions, have emerged as a research issue. One of the early studies in this field for the case of Türkiye was conducted by Destek and Özsoy (2015). They examined the relationship between economic globalization, which is a sub-component of the globalization index, and emissions using annual data from 1970 to 2010. As a result, they asserted that economic integration in Türkiye reduces environmental pollution both in the long and short run. Similarly, Lv and Xu (2018) claimed that economic globalization has had a beneficial effect on environmental recovery in both the short and long run for 15 selected developing countries from 1970–2012. In addition, Lu et al. (2024) and Ximei et al. (2024) used the cross-sectional ARDL method and further supported these findings by showing that economic globalization contributed to environmental sustainability in BRICS-T and APEC countries, respectively.

In contrast to these findings, Phong (2019) conducted a study on five selected Asian countries spanning from 1971 to 2014 and concluded that globalization increases emissions and moreover, economic globalization is the major factor. Xu et al. (2018) enriched the literature in this field by

including economic, social, and political globalization, as well as general globalization. They found that social, political, and general globalization did not cause environmental degradation, but economic globalization increased emissions in Saudi Arabia between 1971 and 2016. Farooq et al. (2022) supported these findings with their results obtained for a large panel of 180 countries using the panel quantile regression method. Destek (2020) aimed to examine the impact of globalization with its sub-components and investigated 12 selected Central and Eastern European countries from 1995 to 2015. In the empirical findings of the study, it was concluded that general and economic globalization caused environmental degradation, political globalization reduced pollution, and social globalization had no significant effect on the environment. Suki et al. (2020) used annual data from 1970 to 2018 for Malaysia with the same purpose. They found that in the long run, general and economic globalization increased the level of environmental degradation, while political and social globalization decreased it.

Recent studies have increasingly focused on alternative environmental metrics, such as the ecological footprint. Figge et al. (2016) were the first to consider the ecological footprint as an explained variable. Their study covered 183 countries and showed that globalization significantly increased pressure on the ecological footprint across these countries, while Ahmed et al. (2019) found that globalization did not significantly affect Malaysia's ecological footprint, but it increased its ecological carbon footprint. Moreover, Bilgili et al. (2019) found that economic and social globalization exacerbated the ecological footprint in Türkiye using nonlinear Markov regime switching models. Similarly, in their study, which included the data of 146 countries from 1981 to 2009, Rudolph and Figge (2017) found that economic globalization increased the ecological footprint, while social globalization decreased it.

More recently, Karaduman (2022) suggested that economic globalization could enhance environmental protection through reducing the ecological footprint across Next Eleven (N-11) countries, a finding echoed by Okere et al. (2022) for the North African region and by Villanthenkodath and Pal (2023) for India. Contrary to this result, Ahmad et al. (2022) and Bekun and Ozturk (2024) concluded that economic globalization increased the ecological footprint in E7 countries. These studies highlight that economic globalization can harm environmental sustainability and thus pointed out the necessity of implementing sustainable development policies.

Overall, the literature revealed a complex and often detrimental relationship between economic globalization and environmental sustainability. While economic globalization drives growth by integrating markets and enhancing trade, it frequently leads to environmental degradation through increased industrial activity and resource consumption. Several studies, such as those by Bilgili et al. (2019) and Ahmad et al. (2022), demonstrated that economic globalization contributes to the increase of the ecological footprint, particularly in developing economies. Moreover, economic globalization's focus on production and consumption often exacerbates CO₂ emissions, as highlighted by Leitão (2013) and Shahbaz et al. (2017). However, some recent research, including that by Pata (2021) and Çetin et

al. (2023), suggested that the negative environmental impact of economic globalization can be mitigated through the adoption of renewable energy. This points to the need for balancing economic integration with sustainable energy practices to counteract the adverse environmental effects of globalization.

3. METHODOLOGY AND DATA

This study investigated how the increase in the level of economic globalization of countries affects their environmental performance and the role of REP in this effect using the PSTR model. In order to provide guidance for other countries, the top 5 countries (Sweden, Switzerland, Norway, France, and Denmark), which have shown the best performance according to the GGEI 2022 report, were included in the research. In addition, the largest possible data set, annual data from 1976 to 2021, was used. Accordingly, the Swiss Economic Research Institute (KOF) economic globalization index (EGI), developed by Dreher (2006) and revised by Gygli et al. (2019), was used to represent the economic globalization levels of the countries.

At the same time, ecological footprint per capita (EF) data were used to represent the environmental performance of the countries. The REP was determined as the transition variable, and the research question was aimed at being answered in the context of the REP. Ecological footprint data were provided by the Global Footprint Network (GFN), and globalization index data were taken from the KOF Globalization Index database. REP data were obtained from the International Energy Agency (IEA).

Table 1. Descriptive Statistics

Variables	Unit	Obs.	Mean	Std. Dev.	Min.	Max.
EF	Global hectares (Gha), per capita	230	6.4945	1.4297	3.7216	9.8222
EGI	Index (from 0 to 100)	230	73.6380	8.5482	50.5851	86.5416
REP	Petajoules (PJ)	230	423.4637	275.0293	16.6704	1149.043

Source: Authors' estimation.

Descriptive statistics prior to the empirical analysis are shown in Table 1. A look at the EF values shows that the lowest value for the whole panel was 3.7216, and the highest was 9.8222, with a mean of approximately 6.5 Gha. In terms of the EGI values, the index data varied between 50.5851 and 86.5416 with a mean value of 73.6380. Finally, REP had a mean of 423.5 PJ with a minimum of 16.7 PJ and a maximum of 1149 PJ.

The PSTR model developed by Gonzalez et al. (2005) was applied to the dataset. This method is a generalized form of the Panel Threshold Regression (PTR) model introduced by Hansen (1999).

These nonlinear methods separate the observations in the panel into homogeneous regimes depending on the value of another observable variable (the threshold variable). In other words, there is a transition between regimes. Therefore, regression coefficients may take different values in different regimes. Moreover, if the threshold variable changes over time, individuals are not restricted to remaining in the same regime in all time periods. However, while both models have these features, unlike the PTR model, the PSTR model allows for a smoother transition between regimes. This makes it more feasible than the PTR model for modeling many economic theories (Gonzalez et al., 2005).

The general PSTR model with two regimes can be defined as follows:

$$y_{it} = \mu_i + \beta'_0 x_{it} + \beta'_1 x_{it} g(q_{it}; \gamma, c) + u_{it} \quad i = 1, \dots, N \quad t = 1, \dots, T \quad (1)$$

Here, y_{it} is the dependent variable, x_{it} is the independent variable, μ_i is the fixed individual effect, and u_{it} is the error. The transition function $g(q_{it}; \gamma, c)$ is a continuous function of the threshold variable q_{it} and only takes a value between 0 and 1. Based on this equation, the following model was constructed to measure the impact of the level of economic globalization (EGI) on environmental performance (EF):

$$EF_{it} = \mu_i + \beta_0 EGI_{it} + \beta_1 EGI_{it} g(q_{it}; \gamma, c) + u_{it} \quad (2)$$

Gonzalez et al. (2005) defined the transition function $g(q_{it}; \gamma, c)$ in the logistic function form as follows:

$$g(q_{it}; \gamma, c) = \frac{1}{1 + \exp[-\gamma(q_{it} - c)]}, \quad \gamma > 0 \quad (3)$$

Here, q_{it} is the natural logarithm of REP (lnREP) used as the threshold variable, c denotes the location (threshold) parameter, and γ is the slope (smoothing) parameter of the transition function. If γ tends to infinity ($\gamma \rightarrow \infty$), the transition function $g(q_{it}; \gamma, c)$ becomes an indicator function that takes the value 1 when $q_{it} > c$ and 0 otherwise. In this case, the transition from one regime to another is very sharp, as in the PTR model. Thus, the model can be estimated using the PTR method. If γ tends to zero, the ($\gamma \rightarrow 0$) transition function $g(q_{it}; \gamma, c)$ equals a constant. In this case, the model is collapsed into the standard linear model that includes cross-sectional effects.

The value of the transition variable (q_{it}) determines the value of the transition function $g(q_{it}; \gamma, c)$, and therefore, the regression coefficients for individual i at time t may be shown as $\beta_0 x_{it} + \beta_1 x_{it} g(q_{it}; \gamma, c)$. If the transition function takes the value 0, the regression coefficients are equal to β_0 , and if it takes the value 1, the regression coefficients are equal to $\beta_0 + \beta_1$. When the transition function takes a value between 0 and 1, the regression parameter is the weighted average of β_0 and β_1

estimates. Therefore, in the PSTR model, instead of directly interpreting the parameter estimates, it is preferable to interpret the sign of the parameters and say that the effect of the independent variable on the dependent variable is positive or negative. In addition, time-varying elasticities for each horizontal cross-section can also be interpreted.

The PSTR model can also be multiple regime, i.e. with more than two regimes. In this case, the PSTR model can be generalized as follows:

$$y_{it} = \mu_i + \beta_0' x_{it} + \sum_{j=1}^r \beta_j' x_{it} g_j(q_{it}^{(j)}; \gamma_j, c_j) + u_{it} \quad (4)$$

The transition function in the multiple regime PSTR model is also as follows:

$$g(q_{it}; \gamma, c) = \left(1 + \exp \left(-\gamma \prod_{j=1}^m (q_{it} - c_j) \right) \right)^{-1}, \quad \gamma > 0, \quad c_1 \leq c_2 \leq \dots \leq c_m \quad (5)$$

In this function, $c = (c_1, \dots, c_m)$ is the m-dimensional vector of the location parameters. The slope parameter γ determines the smoothness of the transition from one regime to another, hence the transition speed. As mentioned before, when γ takes a high value, the transition is completed rapidly; otherwise, the transition is smoother.

In the multiple regime PSTR model, when the transition variable q_{it} is different then the explanatory variable(s), the elasticity is calculated as follows:

$$e_{it} = \frac{\partial y_{it}}{\partial x_{it}} = \beta_0 + \sum_{j=1}^r \beta_j' g_j(q_{it}^{(j)}; \gamma_j, c_j) \quad (6)$$

When the transition variable is a function of one of the explanatory variables, i.e. ($q = x$), the elasticities are estimated as follows:

$$e_{it} = \frac{\partial y_{it}}{\partial x_{it}} = \beta_0 + \sum_{j=1}^r \beta_j' g_j(q_{it}^{(j)}; \gamma_j, c_j) + \sum_{j=1}^r \beta_j' \frac{\partial g_j(q_{it}^{(j)}; \gamma_j, c_j)}{\partial x_{it}} x_{it} \quad (7)$$

PSTR analysis consists of three steps: testing linearity, determining the number of regimes, and estimation. The linearity test is also used to identify the transition variable (q_{it}) in the PSTR model. For this purpose, the test is applied to all candidate transition variables, and the variable that most strongly rejects the linearity is selected as the transition variable. Testing linearity in the PSTR model can be implemented by testing the null hypotheses $H_0 : \gamma = 0$ or $H_0^* : \beta_1 = 0$. However, the location parameters (c) under both hypotheses, β_1 under hypothesis H_0 and γ under hypothesis H_0^* , are not defined. To solve this problem, Gonzalez et al. (2005) replaced the transition function $g(q_{it}; \gamma, c)$ in the PSTR model

by its first-order Taylor expansion around $\gamma = 0$. After reparameterization, the following auxiliary regression is obtained:

$$y_{it} = \mu_i + \beta_0^* x_{it} + \beta_1^* x_{it} q_{it} + \dots + \beta_m^* x_{it} q_{it}^m + u_{it} \quad (8)$$

Testing $H_0 : \gamma = 0$ for the two-regime PSTR model is the same as testing $H_0^* : \beta_1^* = \dots = \beta_m^* = 0$ for an auxiliary regression. Therefore, hypotheses where the null hypothesis is the linear model, and the alternative hypothesis is the PSTR model are tested with the standard F-statistic. The relevant F-statistic is estimated as follows:

$$LM_F = \frac{(RSS_0 - RSS_1) / mK}{RSS_0 / (TN - N - mK)} \square F(1, TN - N - 1) \quad (9)$$

Here, RSS_0 is the sum of the panel error squares of the linear model, while RSS_1 is the sum of the panel error squares of the two-regime PSTR model. According to the LM_F statistic, if the null hypothesis is rejected, the PSTR model may be applied. After rejection of the null hypothesis of linearity, the determination of the number of regimes step is proceeded. At this step, the null hypothesis $H_0 : r = 1$ (the model contains one transition function) is first tested against the alternative hypothesis $H_1 : r = 2$ (the model contains two transition functions). If the null hypothesis is accepted, the process is over. If the null hypothesis is rejected, the null hypothesis $H_0 : r = 2$ is tested against the alternative hypothesis $H_1 : r = 3$. The process of determining the number of regimes lasts until the null hypothesis is accepted. In the estimation step, first, individual effects are eliminated by removing individual-specific means, and then the transformed model is estimated using the Nonlinear Least Squares method.

4. RESULTS AND DISCUSSION

In the panel time series, cross-section dependence and stationarity have to be tested for all panel series before the model estimation steps. Cross-sectional dependence implies that any shock that occurs in a unit affects other units. The results of the analysis, neglecting the existence of this correlation between the units, may be biased and inconsistent. Therefore, as the first step of the analysis, it should be investigated whether there is cross-sectional dependence in all the series. Next, the stationarity of the series should be examined using first-generation panel unit root tests under the assumption that the units are independent from each other; otherwise, second-generation panel unit root tests that take into account cross-sectional dependence should be used.

As the first step of the analysis, the presence of cross-sectional dependence was examined using the Breusch-Pagan CD_{LM} (1980) test, which is more appropriate for the case of $T > N$. While the null hypothesis argues that the units are independent of each other, the alternative hypothesis claims that the cross-sections are dependent on each other. According to the results presented in Table 2, the null

hypothesis was rejected at all conventional significance levels for each series and model. This implies that all the series in the panel were dependent on each other, thus proving the existence of cross-sectional dependence.

Table 2. Cross-Sectional Dependence Test Results

Variables	Breusch-Pagan CD _{LM}	
	Statistics	p-value
EF	107.000	0.000***
EGI	232.800	0.000***
lnREP	61.390	0.000***
MODEL	68.030	0.000***

***, **, and * denote 1%, 5%, and 10% significance, respectively.

The second-generation cross-sectionally augmented Im–Pesaran–Shin (CIPS) panel unit root test, developed by Pesaran (2007), which takes into account cross-sectional dependence, was applied to check the stationarity of the series. The results of the CIPS test are given in Table 3. The main hypothesis of the test argues for the existence of a unit root. When the test statistics given in the analysis results were compared with the critical values, the null hypothesis was strongly rejected at all significance levels. Thus, it can be said that all the variables were stationary, both in the model with the constant and in the model with the constant and trend.

Table 3. CIPS Panel Unit Root Test Results

Variables	CIPS	CIPS
	Constant	Constant and Trend
EF	-3.397***	-3.546***
lnREP	-3.532***	-3.942***
EGI	-3.040***	-3.357***
	Critical Values	
1%	-2.55	-3.06
5%	-2.33	-2.84
10%	-2.21	-2.73

***, **, and * denote 1%, 5%, and 10% significance, respectively.

It was decided that PSTR analysis was appropriate according to the results of the cross-sectional dependence and unit root analyses. The first step in PSTR analysis is testing the linearity. The test also shows whether the regime switching in the series is significant or not. In addition, the linearity testing step of the PSTR analysis is also used to determine the transition variable, as suggested by Colletaz and Hurlin (2006). The procedure is iterated for all possible transition variables, and the variable that most

strongly rejects the linearity is determined as the transition variable. Table 4 shows the linearity test results of the model in which REP is determined as the transition variable. While the main hypothesis holds that the relationship between economic globalization and environmental pollution is linear, the alternative hypothesis says that there is a nonlinear relationship with at least two regimes. According to the analysis findings, the linearity hypothesis was strongly rejected for both $m = 1$ and $m = 2$.

Table 4. Linearity Test Results

H ₀ : Linear model ($r = 0$)	$m = 1$		$m = 2$	
	Statistics	[p-value]	Statistics	[p-value]
H ₁ : PSTR model with at least ($r = 1$)				
Wald Test (LM)	38.768	[0.000]	52.233	[0.000]
Fisher Test (LM _F)	45.412	[0.000]	32.762	[0.000]
Likelihood Ratio Test (LRT)	42.457	[0.000]	59.249	[0.000]

Source: Authors' estimation. Lagrange Multiplier (LM), Lagrange Multiplier of Fisher (LM_F).

Table 5. Test of No Remaining Nonlinearity Results

H ₀ : PSTR model with ($r = 1$)	$m = 1$		$m = 2$	
	Statistics	[p-value]	Statistics	[p-value]
H ₁ : PSTR model with at least ($r = 2$)				
Wald Test (LM)	4.249	[0.039]	3.795	[0.150]
Fisher Test (LM _F)	4.179	[0.042]	1.854	[0.159]
Likelihood Ratio Test (LRT)	4.289	[0.038]	3.826	[0.148]

Source: Authors' estimation.

As mentioned before, when the relationship between variables is found to be nonlinear, the number of regimes should be determined. For this purpose, the analysis was iteratively applied until the null hypothesis could not be rejected. Table 5 shows the test results comparing the model with two regimes against the model with at least three regimes. According to the findings, the two-regime PSTR model with one threshold could not be rejected for $m = 1$ and $m = 2$. There was a two-regime nonlinear relationship between economic globalization and environmental pollution.

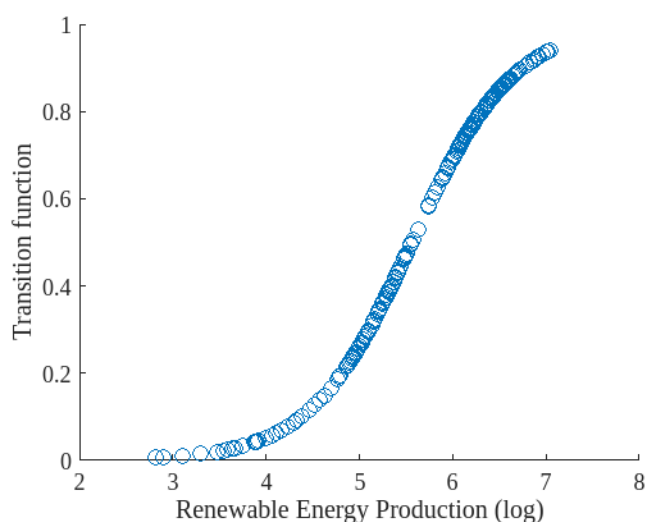
Table 6. Determination of the Appropriate Location Parameter

	$m = 1$	$m = 2$
RSS	82.818	84.225
AIC	-0.965	-0.935
BIC	-0.905	-0.860

Source: Authors' estimation. Residual sum of squares (RSS), Akaike Information Criterion (AIC), Bayesian Information Criterion (BIC).

The decision on the appropriate location parameter was based on the RSS, AIC, and BIC. The values are provided above, in Table 6. The model with the lowest RSS, AIC, and BIC information criteria was chosen. Thus, the PSTR (1, 1) model with one threshold and one transition function was determined to be the appropriate model.

Figure 1. Estimated Transition Function



The final estimation step of the PSTR model was executed following the determination of the number of regimes and location parameters. Figure 1 shows the transition function plotted against the REP. According to the findings of the two-regime PSTR model with one location parameter analysis given in Table 7, the coefficients were statistically significant. The slope parameter (γ) was determined as 1.8525. This means that the transition between the regimes was smooth. Figure 1 also supports the conclusion that the transition from the low to the high production regime was quite smooth. The threshold value separating these two regimes was 260.2 PJ. According to the graph of the REP given in Figure 2, except for Switzerland in 2021, Switzerland and Denmark were placed entirely in the low production regime, while Sweden, Norway, and France were in the high production regime.

Figure 2. REP Levels of the Countries

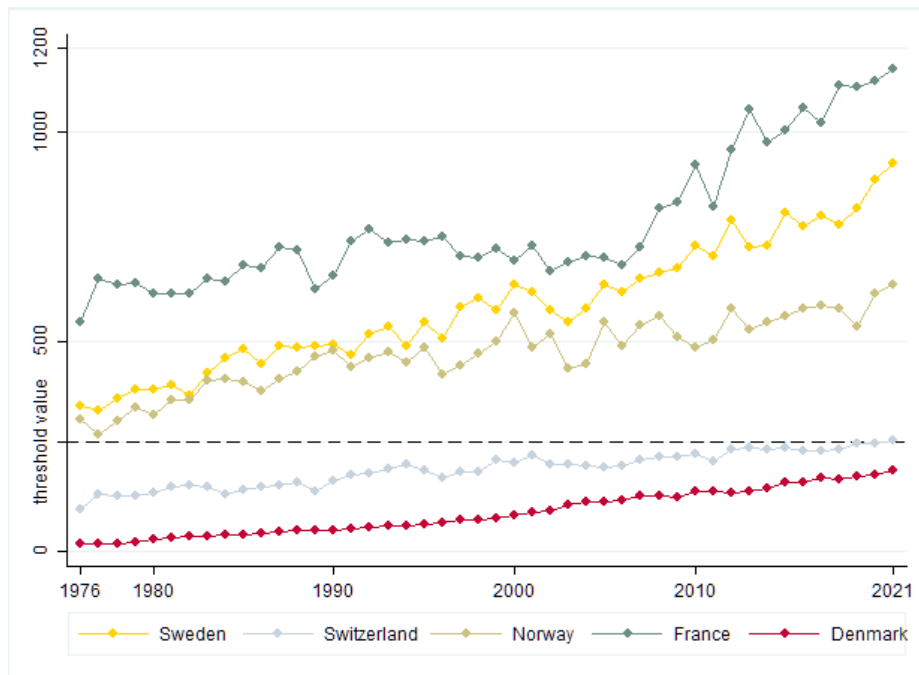


Table 7. PSTR Model Estimation Results

Variables	PSTR (1, 1)	
	β_0	β_1
EGI	0.0806 (4.7568) ^a	-0.1092 (-8.1686) ^a
Threshold value (c)	5.5615 (260.2 PJ)	
Slope parameter (γ)	1.8525	

^a Indicates t-statistics corrected for the heteroskedasticity of the coefficients.

The empirical results showed that in the first regime, where the REP was lower than 260.2 PJ, the increase in the level of economic globalization affected the per capita ecological footprint positively ($\beta_0 = 0.0806$) and caused an aggravation of environmental degradation. However, in the second regime, where the REP was higher than 260.2 PJ, the effect of economic globalization on the ecological footprint switched to negative ($\beta_0 + \beta_1 = 0.0806 - 0.1092$) and decreased environmental degradation. The results of the first regime, that economic globalization causes environmental degradation, contradict the results of Destek and Özsoy (2015) but are also consistent with the results of Rudolph and Figge (2017), Xu et al. (2018), Phong (2019), Bilgili et al. (2019), Destek (2020), Suki et al. (2020), and Pata (2021). However, considering the results for the second regime, the results are consistent with those of Destek and Özsoy (2015). The current findings showed that although economic globalization is a factor that increases environmental degradation, this effect can be eliminated by increasing REP.

5. CONCLUSION

This paper aimed to investigate how the economic globalization levels of countries affect their environmental performance and, moreover, determine the role of REP in this effect. In order to achieve this, the nonlinear PSTR model was applied to annual data for Sweden, Switzerland, Norway, France, and Denmark for the period of 1976 to 2021. In addition, these countries were not randomly selected; they are the top five best-performing countries according to the Global Green Economy Index 2022 report. It was expected that, due to the high performance of these countries in the field of green economy by adopting environmentally friendly policies, the results may encourage other countries. In this paper, EF data were used to represent environmental pollution, the KOF EGI was used to represent economic globalization, and REP was determined as a transition variable.

The findings suggest that there is a nonlinear, two-regime relationship between environmental pollution and the level of economic globalization. The threshold value separating the regimes was 260.2 PJ, and the transition between regimes was quite smooth. In the first regime, where REP was below the threshold value, economic globalization had a positive effect on the ecological footprint, while this effect switched to negative in the second regime, which was the high production regime. This means that the increase in the level of economic globalization had an increasing impact on environmental degradation; however, this impact was eliminated by increasing REP. Except for Switzerland's observation in 2021, Switzerland and Denmark were in the low production regime, while Sweden, Norway, and France were in the high production regime. Thus, Switzerland and Denmark, in particular, should consider developing policies to increase REP.

Climate change resulting from environmental degradation has become today's global crisis. This study showed that one of the causes of this problem is international economic integration, as a result of the industrial development and technological progress of the modern world. This result was reached despite the fact that the countries in the study have been successful in fighting against climate change. Moreover, in a regime where REP is high, this environmental degradation caused by economic integration was eliminated and contributed to environmental quality. Consequently, in order to achieve environmental and sustainable development targets, policymakers are advised to develop policies and implement more investments to promote REP.

The study does not necessitate Ethics Committee permission.

The study has been crafted in adherence to the principles of research and publication ethics.

The authors declare that there exists no financial conflict of interest involving any institution, organization, or individual(s) associated with the article. Furthermore, there are no conflicts of interest among the authors themselves.

The authors contributed equally to the entire process of the research.

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The Effect of Smartphone Features on Customer Engagement: The Mediating Role of Brand Value

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Abstract

The continuous increase in the use of smartphones and the rapid growth in the demand for these devices increase the interest in the subject. The smartphone market has attracted the attention of many businesses due to the increasing usage rates and has resulted in new brands and models joining the competition in the market. This research aims to examine the relationships between smartphone features, customer engagement, and brand value in the context of Turkish smartphone users. For this purpose, a theoretical model is proposed to encompass the interactions between these variables. The model is tested by analyzing the data obtained from 726 Turkish smartphone users. The findings reveal that smartphone features have a strong influence on brand value and brand value has a strong influence on customer engagement. Smartphone features alone do not affect customer engagement. On the other hand, brand value is found to mediate the relationship between smartphone features and customer engagement.

Keywords: *Smartphone Features, Customer Engagement, Brand Value, Consumer Behavior*



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1. INTRODUCTION

The mobile telephony market is one of the fastest-growing service segments in telecommunications. The mobile telephony industry is also a highly innovative segment, with the smartphone becoming the standard configuration across different types of mobile devices. Although devices offering phone and computer features were developed in the 1970s, the commercial success of smartphones began in late 2006 with the launch of the Blackberry. Apple launched the first iPhone model in 2007 and shortly afterwards Samsung produced the Samsung Instinct in June 2008 as a competitor to the iPhone. Since then, the smartphone market has witnessed intense competition among incumbents and new entrants. Since 2008, the smartphone industry has grown steadily in terms of market size and number of models and manufacturers. The number of smartphone subscriptions exceeds the number of users, as many people use more than one smartphone (Bacalhau, 2023, p. 9; Cecere et al., 2015). Out of the global population of over eight billion (8.05 billion), 86% (6.93 billion) use smartphones. This figure is expected to reach 7.7 billion by 2027. The share of smartphones in web traffic is 59% and the average daily time spent on smartphones is 5 hours and 25 minutes. It is predicted that 72.6% of internet users worldwide will access websites through their smartphones in 2025 (Mobisad, 2023, p. 13). The number of smartphone users in Turkey is projected to increase by 13.5% between 2024 and 2029, gaining approximately ten million new users and reaching a new peak of 84.07 million users in 2029. This upward trend has steadily risen in the past years (Dierks, 2024). Smartphones are rapidly becoming one of the most effective tools for marketing since the advent of the Internet (Hanley & Becker, 2006, p. 68).

One of the most important issues in launching a new product is identifying the features that will enable a product to capture the highest market share. Compared to older phones, smartphones offer many features in addition to information such as speech capabilities and text messages. The technological development of the smartphone and the efficiency of the phone are important factors in choosing the appropriate marketing style. New smartphones have large screens and high volumes of storage space, which contribute to the marketing template (Alghizzawi et al., 2018, p. 92). Most products emerging in the smartphone market seem to reflect the belief among manufacturers that more features are necessary to be competitive. Some users, for example, early adopters, may want many features in the products they buy (Glasscock & Wogalter, 2006, p. 1259). According to one study, the loyalty of users of goods and services and the quality of the visitor base directly influence the expected outcomes of the service or good (Ström et al., 2014).

Thoughtful companies will seek to fully understand the customer's decision-making process, and their entire experience of learning, choosing, using, and even adopting products. Between alternative processes and decision-making is consumer buying interest. Purchase interest arises after an alternative evaluation process and during the evaluation process, the person makes a series of choices about the product to be purchased based on brand and interest (Kotler et al., 1999; Kotler and Keller, 2016).

Bacalhau (2023), through interviews and surveys, reveals the key factors that influence consumer preferences in the smartphone market. According to the research, factors such as build quality, camera quality, ecosystem compatibility, price, and memory have a great influence on purchasing decisions. Arif et al. (2015) show in their study that the majority of smartphone users will primarily consider product features. The smartphone provider should investigate which features users demand, such as higher image resolution of the camera, better and faster operating system, smarter and lighter design, and other innovative product features for both software and hardware. Economides et al. (2009) investigated students' perceptions of the importance and costs of mobile devices. It was found that users tended to consider features such as battery life, mp3 player, video camera, still camera, storage memory, Bluetooth, design and elegance, clock, calendar, organizer and reminder as important. Çakır et al. (2014) concluded in their study on students that product features, brand and advertising efforts affect users' smartphone purchase preferences. Uludağ et al. (2018) conducted a study on the mediating role of customer satisfaction in the effect of brand image on customer loyalty in the smartphone market. As a result of the study, it was determined that brand image has an impact on customer satisfaction and customer loyalty, and at the same time, customer satisfaction directly affects customer loyalty. In addition, it was concluded that customer satisfaction is a 'partial mediator' variable in the effect of brand image on customer loyalty.

2. LITERATURE REVIEW

2.1. Smartphone Features

Product features relate to attributes that are intended to meet customers' needs and increase satisfaction by facilitating product use (Kotler & Armstrong, 2007). For smartphones, product features are divided into hardware and software. Hardware includes physical features (design and size, etc.) and software includes operating systems and applications (Lay-Yee et al., 2013). In this study, 17 different features of smartphones highlighted by the literature and the researcher were evaluated: design, operating system, storage capacity, battery life, screen size, screen resolution, security, camera and lens, sound system, durability, RAM, device size, device weight, wireless and fast charging, software, price, warranty, and service support (Glasscock & Wogalter, 2006).

Design, which is evaluated in terms of ergonomics and aesthetic preferences, enables stylish and useful devices to be carried comfortably in daily life (Bloch, 1995; Crilly et al., 2004). Industrial designers and manufacturers should consider individual preferences in product design (Glasscock & Wogalter, 2006). The operating systems that run the basic software and user interface of the device are usually specified and installed by the manufacturer. They enable consumers to use their devices and applications. The most common operating systems are iOS and Android (Arif et al., 2015, p. 113). Storage capacity refers to the space available for apps, music, photos, videos, and files. High storage capacity allows users to store more data and is expressed in gigabytes (GB). Battery life determines how long the device can be used on a single charge and is expressed in hours. Long battery life allows users

to charge their devices less frequently, which offers ease of use. Small screens provide ease of transportation, while large screens are preferred for multimedia consumption. Screen resolution determines the amount and density of pixels, delivering sharper and more detailed images. High resolution significantly improves the user experience. Security encompasses security measures that protect users' personal data and online activities. It includes technical and software measures such as password protection, security updates, and data encryption. Camera and lens are hardware components that provide the ability to take photos and videos. The quality of the camera and lens greatly affects shooting quality and user experience. Audio systems include hardware and software components that provide the necessary audio output for phone calls, media listening, and voice applications. Durability refers to the device's resistance to environmental factors such as water, dust, impact, and thermal effects. Durability ensures that the device is safe for daily use and extends its lifespan. RAM is a type of temporary memory that enables fast and efficient operation of the device. RAM enables multitasking and fast switching between applications. The size and weight of the device have a significant impact on portability and user comfort. It is usually specified in grams/ounce. Wireless charging allows users to charge their devices without using cables. Fast charging allows devices to be charged in less time. Price refers to the cost of the device and is an important factor in users' purchasing decisions. The price is determined by factors such as the device's hardware specifications, brand, model, and market demand. Warranty and service support provides users with protection and technical support against problems they may experience after purchasing a device. The warranty covers the protection of the device against manufacturing defects within a certain period and provides after-sales technical support. Cecere et al. (2015) investigate whether a dominant design has emerged in the smartphone industry. In particular, they examine the evolution of hardware components based on an original product specification dataset that includes all smartphones released between 2004 and 2013. The results show that despite some convergence in the introduction of vertical innovations, product differentiation still characterizes competition among manufacturers and a dominant design has not yet emerged.

2.2 Customer Engagement

The concept of engagement, which is based on fields such as psychology and organizational behavior, has also found a place in the marketing literature and preliminary research has revealed that consumers who show engagement may show more loyalty to focus brands. Kahn (1990) considered engagement in the business world as personal engagement (Kahn, 1990). Personal engagement is defined as the level of integration between individuals' interests and work tasks. Customer engagement (CE) is defined as a psychological state or process that leads to customer loyalty (Brodie et al., 2011). Customer engagement research has received increasing attention due to its critical role in generating outcomes such as positive customer experience and brand trust, which in turn influence future purchase intentions (Vivek et al., 2012; Harrigan et al., 2017).

Bowden (2009) defines customer engagement as the psychological mechanisms that explain the process by which a service brand builds loyalty in new customers and maintains loyalty in existing customers (Bowden, 2009). Ilić (2008) defines customer engagement as a contextual process that consists of interactions with commitment objects over time and can exist at different levels. Patterson et al. (2006) define customer engagement as the level of physical, cognitive, and emotional presence in a customer's relationship with a service organization (Hollebeek, 2011, p. 791). Customer engagement refers to how consumers' intrinsic motivations strengthen their level of identification with the brand community and its positive outcomes through interacting or collaborating with brand community members. Research shows that committed customers value their relationship with the business, are less sensitive to price, contribute to the business's knowledge acquisition process by providing feedback, shop more, avoid opportunistic behavior, and tend to play a more active role in product and service processes by cooperating with the business (Altunoğlu & Saraçoğlu, 2013).

Researchers define customer engagement from two different perspectives: cognitive and behavioral. The cognitive perspective includes elastic, behavioral, and emotional components, while the behavioral perspective focuses on customer engagement and experience (Brodie et al., 2011; van Doorn et al., 2010). According to Brodie et al. (2011), customer engagement, experience, and shared values contribute to relationship marketing. Customer engagement is conceptualized as holistic brand relationships (Kumar & Pansari, 2016), cognitive and behavioral components (Hollebeek et al., 2014), and processes that lead to customer loyalty (Bowden, 2009), driven by personal motivations such as sharing information, blogging, and recommendations. Specifically in the smartphone context, cognitive engagement refers to customers' focus on the smartphone and its brand; affective engagement refers to the long-term excitement and satisfaction experienced while using the smartphone; and behavioral engagement refers to plans to use the brand. Customer engagement refers to a customer's strong commitment and desire to maintain a relationship with a brand or brand organization (Hollebeek, 2011).

Customer engagement is not limited to repeatedly buying the same brand. It includes the customer's tendency to continue to prefer the same brand even when competitors offer more attractive offers (Nguyen & Leblanc, 2001, p. 229). In this context, customer engagement can be defined as the consumer's attitude or behavior of frequently choosing a particular product, service, brand, or place of shopping among many alternatives. According to another definition, customer engagement involves a customer's desire to recommend or maintain a relationship with the business that he/she has been shopping with (Too et al., 2001, p. 292). Engagement can also be expressed as a customer's preference for a particular brand or store, continuing to search for it even if they cannot reach it, and even defending it when necessary. Research shows that customer engagement positively affects business performance. Engagement customers can increase the profitability of the business through repeat purchases and therefore customer loyalty provides a significant competitive advantage for the business. The cost of acquiring new customers is higher than the cost of retaining old customers, which emphasizes the

importance of customer engagement (Kim & Yoon, 2004, p. 757). In the literature, the existence of a direct link between customer engagement and behaviors such as loyalty has been consistently emphasized. However, it may be useful to evaluate this relationship through the mediation process. In this study, the mediating effect of brand value on customer engagement is investigated.

2.3. Brand Value

Brand value is treated as both an asset and a process by the most influential national and international studies. These studies focus on well-established brands and provide strong evidence that brand value is a source of value and an indicator of superior performance for businesses (Parris & Guzmán, 2023, p. 195). Brand value is a critical element in terms of both the value it offers to consumers and the competitive advantage it provides to businesses.

Farquhar (1989) defined brand value as the added value that a brand adds to a product, resulting from a consumer's positive evaluation or attitude towards the branded product (Farquhar et al., 1989, p. 24). Aaker (1991) defines brand value as the sum of the assets and liabilities associated with the brand name and symbol that increase or decrease the value offered to a business or its customers through a product or service. Keller (1993) defined brand value as the difference that brand information creates in consumer reactions. Keller's approach emphasizes that intangible activities are more difficult to market than tangible activities. In this context, it is argued that consumer-based brand value stems from more positive responses to the marketing efforts of businesses (Keller, 1993, p. 8). Doyle (2008) evaluates the brand value of businesses by examining the intangible assets they possess, asserting that the true capital of many businesses today lies in their brands (Kapferer, 2012). Alkibay (2005) emphasizes that brand value is the additional value added to the product by the positive impressions created by the brand symbol and name in the minds of consumers. Erdil (2015) stated that the concept of brand value is especially important in the event of the sale of the brand with all its assets or mergers. In addition, the brand is an important tool in determining comparative positioning with other competing businesses. Kriegbaum (1998) states that the brand has come to the forefront as a competitive tool and that protecting and increasing the brand value of businesses is a competitive strategy. Brand value is important as it provides a competitive advantage, creates customer loyalty, and enables the brand to charge high prices for its products. Knapp (2003) states that the formation of brand value depends on the responsibility of all business employees. In this context, the feelings and thoughts of the brand's partners, employees, and consumers towards the brand play a critical role in the creation of brand value.

Haudi et al. (2022) state that trust in marketing is a catalyst for establishing and maintaining long-term relationships and is an element that leads to a unique brand value and differentiation that is engraved in the minds of consumers. Aaker (1996) states that depending on the effectiveness of brand value, repurchase of products or services and loyalty to the brand increase, which enables the brand to develop new products and services and transfer brand value to these products/services.

What is clear from the previous and subsequent discussions is that brand value is a multidimensional construct, and any measurement attempt needs to recognize these different dimensions (Faircloth et al., 2001, p. 63). Brand value has been studied from a variety of perspectives, from the point of view of producers, retailers or consumers, and analyzed whether its benefits are felt by the business or consumers (Christodoulides et al., 2015). Academic studies address brand value from two main perspectives: the financial perspective and the consumer perspective. The financial perspective was widely adopted in the 1980s and 1990s. This approach considers the brand as a distinguishable asset that can be sold for its monetary value or included in the balance sheet (Simon & Sullivan, 1993; Kim & Kim, 2005; Emari et al., 2012; Buil et al., 2013). The financial value of a brand is a critical indicator for business and plays an important role in strategic decision-making processes. The consumer perspective, which has been widely used since the late 1980s, began to receive intense attention in the 1990s (Keller, 2010; Taşçı, 2020). This approach is known as customer-based brand value (CBBE) and measures consumers' knowledge, attitudes, associations, and loyalty to a brand. The strength of the brand is based on what consumers learn, feel, see, and hear about the brand and this represents the value that the brand adds to the product (Yoo & Donthu, 2001; Keller & Lehmann, 2006; Londoño et al., 2016; Taşçı, 2021). Brand value is a complex construct that needs to be measured from both financial and consumer perspectives. The financial perspective evaluates brand value within business assets and measures it in terms of monetary value. This method concretizes the contribution of the brand to financial performance and allows the brand to be seen as a saleable asset. The consumer perspective, on the other hand, assesses brand value based on consumers' perceptions and experiences with the brand. This approach measures the values and associations that the brand creates in the minds of consumers. Consumer-based brand value determines the strength of a brand based on what consumers learn, feel, see, and hear about the brand (Aaker, 1991; Keller, 1993).

Faircloth et al. (2001) examined the effects of brand attitude and brand image on brand value. This study reveals that brand value can be manipulated by specific brand associations and that these associations shape brand value by influencing image and attitudes. They also concluded that focusing on the constructs that create brand value is more meaningful than trying to measure it as financial performance. Haudi et al. (2022) examined the effects of social media marketing activities on brand trust, brand value, and brand loyalty. The results of the study show that social media marketing has positive effects on all three elements. In addition, brand trust, brand value, and brand loyalty have positive effects on the performance of businesses. These studies reveal how important brand value is for businesses and how it is evaluated from different perspectives. Brand value both increases the competitiveness of businesses as an indicator of intangible assets and plays a critical role in strengthening relationships with consumers. Therefore, strategies to protect and enhance brand value are indispensable for the long-term success of businesses.

3. METHODOLOGY

A quantitative research method based on numerical data was used to test the hypotheses developed by the research model. Data were collected using a survey technique. The research population consists of Turkish smartphone users over the age of 18. Due to the impossibility of reaching all Turkish smartphone users and time constraints, the convenience sampling method was preferred. The data were collected between January and May 2024 and the questionnaire were filled in online. A total of 726 participants were surveyed. Since the questionnaires were online and the questions were compulsory, there was no data loss and all questionnaire forms were evaluated.

The items related to smartphone features in the questionnaire form were compiled by the researcher and adapted from the items in the customer engagement scale (Li, 2021) and the items in the brand value scale (Avcı, 2023). In addition, six questions were asked to determine the demographic characteristics of the respondents, followed by a single question to determine the duration of smartphone usage. All scales in this study were measured using a five-point Likert scale.

3.1. Research Model Hypoteses

Research on the effects of product features on customer engagement has revealed that these attributes have positive effects on customer engagement (Hollebeek, 2011; Nguyen & Leblanc, 2001; Too et al., 2001; Vivek et al., 2012; Altunoğlu and Saraçoğlu, 2013). In addition, there are many studies show that product features have positive effects on brand value (Faircloth et al., 2001; Haudi et al., 2022; Parris and Guzmán, 2023). Increasing brand value is generally associated with increasing customer engagement (Warrington & Shim, 2000; Yuniari, 2020; Larasati & Hananto, 2012). In this context, it is stated that product features have the potential to increase customer engagement. This relationship is believed to be effective through the value of the brand.

A model was developed for the research (Fig. 1). The data obtained through the questionnaire technique were tested using quantitative research methods. In the light of this information, the research hypotheses were formed as follows.

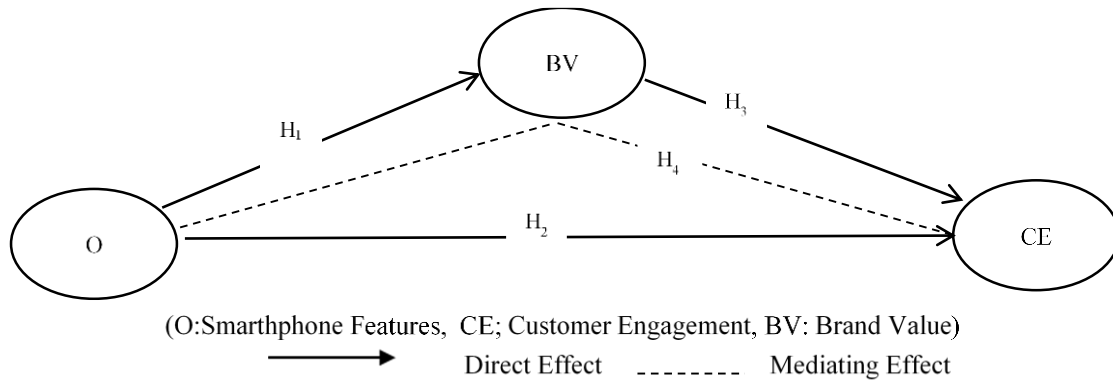
H₁: Mobile phone features affect brand value.

H₂: Mobile phone features affect customer engagement.

H₃: Brand value affects customer engagement.

H₄: Brand value has a mediating effect on the effect of mobile phone features on customer engagement.

Figure 1. Research Model



3.2. Test of Scale

To demonstrate the construct validity of the measurement model, a first-order single-factor confirmatory factor analysis (CFA) was conducted using the AMOS 22 statistical package program. Since the numbers obtained from the analysis did not meet the appropriate fit values, the changes suggested by the program were applied. For this purpose, three covariates were created in the smartphone features dimension, one covariate in the customer commitment dimension, and one covariate in the brand value dimension. As a result of the modifications, the recommended fit values were obtained.

Table 1. Goodness-of-Fit Indices for the Scales

	χ^2	df	χ^2/df	GFI	CFI	RMSEA
Model fit values	1566.190	396	3.955	.867	.945	0.64
Good fit values*			≤ 3	≥ 0.90	≥ 0.97	≤ 0.05
Acceptable fit values *			$\leq 4-5$	$\geq 0.89-0.85$	≥ 0.95	$\leq 0.06-0.08$

*Source: (Meydan & Şeşen, 2015, p. 37)

Since the goodness-of-fit values ($\chi^2/df= 3.955$; $RMSEA= 0.64$; $CFI= 0.945$; $GFI=.867$) of the measurement model derived from the one-factor confirmatory factor analysis (CFA) fell within acceptable ranges, the construct validity of all scales was established. Table 2 shows the factor loadings and reliability coefficients of the items in each scale. Cronbach's alpha coefficients for all scales in Table 2 range from 0.912 to 0.966. Since the coefficients were within acceptable limits, all scales proved to be reliable.

Table 2. Factor Loadings of Scales, Reliability, and Validity Coefficients

Factors	Item	Code	Factor loadings	Cronbach Alpha	Skewness	Kurtosis
Smartphone Features (O)	Design	O1	.829	.966	-.946	.513
	Operating system	O2	.860		-.977	.353
	Storage capacity	O3	.736		-.741	-.478
	Battery life	O4	.860		-.404	-.848
	Screen size	O5	.858		-1.182	1.154
	Screen resolution	O6	.842		-1.000	.360
	Security	O7	.842		-.943	.256
	Camera and lens	O8	.894		-.717	-.650
	Sound system (speaker)	O9	.871		-.817	-.140
	Durability (dust, water, etc.)	O10	.849		-.857	-.119
	RAM (Cache)	O11	.817		-.831	-.086
	Device size	O12	.889		-1.022	.480
	Device Weight	O13	.570		-.926	.311
	Wireless and Fast Charging	O14	.803		-.831	-.337
	Software	O15	.829		-.836	-.174
	Price	O16	.860		-.425	-.787
	Warranty and service support	O17	.736		-.721	-.280
Customer Engagement (CE)	Using this brand makes me think about it.	CE1	.855	.940	-.293	-1.107
	When I use this brand, I frequently think of it.	CE2	.769		-.008	-1.119
	Using this brand makes me want to learn more about it.	CE3	.828		-.229	-1.134
	I feel confident when I use this brand.	CE4	.936		-.199	-1.124
	Using this brand makes me joyful.	CE5	.930		-.580	-.852
	I feel better when I use this brand.	CE6	.751		-.442	-1.007
	I'm proud to utilize this brand.	CE7	.934		-.057	-1.175
	I will continue to use this brand compared with other car brands.	CE8	.924		-.607	-.942
	Whenever I buy an automobile, I will give preference to the brand.	CE9	.919		-.486	-1.187
	When I decide to buy or change an automobile, this brand is one of the brands I will always choose.	CE10	.855		-.647	-.952
Brand Value (BV)	I consider myself brand loyal.	BV1	.702	.912	-.481	-.888
	The brand would be my first choice.	BV2	.863		-.595	-1.043
	In general, I believe that the brand is a high quality business/organization.	BV3	.871		-.809	-.473
	The brand competes with other brands.	BV4	.619		-.766	-.559
	It is worth the money and time I spend to buy the brand.	BV5	.782		-.615	-.661
	I can distinguish the brand among other brands.	BV6	.778		-1.023	-.080
	I can quickly recognize the brand's logo.	BV7	.758		-1.259	.278
	Some characteristics/features of the brand come to mind quickly.	BV8	.702		-.899	-.342

4. FINDINGS

4.1. Characteristics of the Sample

The findings of the frequency analysis used to determine the characteristics of the participants are given in Table 3. Although the sample was determined by convenience sampling method from the universe of Turkish smartphone users over the age of 18, it is seen that the majority of the participants are between the ages of 18-35, lower income group and students.

Table 3. Characteristics of the Sample

Gender	n	%	Marital status	n	%
Male	381	52.5	Married	72	9.9
Female	345	47.5	Single	654	90.1
Total	726	100.0	Total	726	100.0
Age	n	%	Education	n	%
Ages 18-25	469	64.6	Primary Education	16	2.2
Ages 26-35	214	29.5	High school	148	20.4
Ages 36-45	18	2.5	Bachelors Degree	515	70.9
Ages 46-65	25	3.4	Master's Degree/PhD	47	6.5
Total	726	100.0	Total	726	100.0
Occupation	n	%	Monthly Income	n	%
Student	376	51.8	10.000 TL and below	261	36.0
Self Employed	150	20.7	10.001-17.002 (Minimum wage)	209	28.8
Retired	7	1.0	17.003-30.000 TL	165	22.7
Housewife	20	2.8	30.001-50.000 TL	48	6.6
Private Sector	144	19.8	50.001-100.000 TL	29	4.0
Public Sector	29	4.0	100.001 TL and above	14	1.9
Total	726	100.0	Total	726	100.0

When Table 3 is analyzed, it is seen that more than 52% of the participants are male and approximately 48% are female. Approximately 10% of the participants are married and approximately 90% are single. The highest number of participants is between the ages of 18-25 with 64.6%. The 26-35 age range comes second with approximately 30%. More than 70% of the participants have a bachelor's degree. The rate of high school graduates is approximately 20%. More than 51% of the participants are students, about 20% are self-employed and the other 20% are private sector employees. It is seen that more than 60% of the participants have an income below 17.002 TL. The rate of those with an income between 17002-30000 is 22.7%.

Table 4. Smartphone Usage Duration

Duration of Use	n	%
1 year and less	195	26.9
2-5 years	380	52.3
6-10 years	138	19.0
11 years and more	13	1.8
Total	726	100.0

Participants were asked how long they had been using their smartphones. 26.9% of the participants have been using their smartphones for 1 year or less, 52.3% for 2-5 years, 19% for 6-19 years, and 1.8% for 11 years or more. Approximately 80% of the participants change their smartphones within five years.

Table 5. Smartphones Use Characteristics

Smartphone Brand	n	%	Ranking	Alternative Smartphone Brand	n	%
Iphone	334	46	1	Iphone	393	54,1
Xiaomi	138	19	2	Samsung	256	35.3
Samsung	137	18.9	3	Xiaomi	35	4.8
Oppo	29	4	4	Huawei	22	3.0
Huawei	26	3.6	5	Oppo	9	1.2
Diğer	23	3.2	6	Infinix	2	.3
Realme	12	1.7	7	Tecno	2	.3
Infinix	8	1.1	8	Realme	2	.3
Tecno	6	0.8	9	Reeder	1	.1
General mobile	6	0.8	10	General Mobile	1	.1
Omix	4	0.6	11	Alcatel	1	.1
Reeder	2	0.3	12	Honor	1	.1
Gigaset	1	0.1	13	Other	1	.1
Total	726	100.0		Total	726	100.0

When the participants ranked the smartphone brands they use, the top 5 brands were iPhone, Xiaomi, Samsung, Oppo, and Huawei. More than 80% of the participants use the first 3 brands. The least used brands were Gigaset, Reeder, and General Mobile. Participants were asked, "If you do not use this brand, which brand would you like to use?". The top 5 brands they would like to use were iPhone, Samsung, Xiaomi, Huawei, and Oppo, respectively. The brands currently used and the top 5 brands that would like to be used are the same.

4.2. Descriptive Statistics

The mean and standard deviation values of the items in the smartphone features, customer commitment, and brand value scales are shown in Table 6. Among the smartphone features, "Screen size" has the highest mean (4.035), while "Price" has the lowest mean (3.431). On the customer loyalty scale, the statement "When I decide to buy or change a smartphone, this brand is one of the brands I will always prefer." has the highest mean (3.661), while the statement "When I use this brand, I often think of the brand." has the lowest mean (3.059). In the brand value scale, the statement "If this brand gives me good service, I will convey my satisfaction to the authorities" has the highest mean (3.526), while the statement "I write comments on the forums of this brand" has the lowest mean (2.413).

Table 6. Descriptive Statistics of Scale Items

Code	Items	N	Mean	S.E.
Smartphone Features				
O1	Design	726	3.9421	1.04490
O2	Operating system	726	3.8981	1.11322
O3	Storage capacity	726	3.6956	1.26367
O4	Battery life	726	3.4353	1.25201
O5	Screen size	726	4.0358	1.01782
O6	Screen resolution	726	3.9421	1.09643
O7	Security	726	3.9325	1.09399
O8	Camera and lens	726	3.7121	1.30929
O9	Sound system (speaker)	726	3.8581	1.14011
O10	Durability (dust, water, etc.)	726	3.7948	1.20368
O11	RAM (Cache)	726	3.8223	1.15793
O12	Device size	726	3.9421	1.10145
O13	Device Weight	726	3.8857	1.08374
O14	Wireless and Fast Charging	726	3.7590	1.26645
O15	Software	726	3.8292	1.18428
O16	Price	726	3.4311	1.26494
O17	Warranty and service support	726	3.7273	1.19193
Customer Engagement / Cognitive Engagement				
CE1	Using this brand makes me think about it.	726	3.3857	1.36458
CE2	When I use this brand, I frequently think of it.	726	3.0592	1.35771
CE3	Using this brand makes me want to learn more about it.	726	3.2741	1.36278
Affective Engagement				
CE4	I feel confident when I use this brand.	726	3.2576	1.35791
CE5	Using this brand makes me joyful.	726	3.5882	1.35436
CE6	I feel better when I use this brand.	726	3.4807	1.35607
CE7	I'm proud to utilize this brand.	726	3.1350	1.38901
Behavioral Engagement				
CE8	I will continue to use this brand compared with other smartphone brands.	726	3.6281	1.39733
CE9	Whenever I buy an smartphone, I will give preference to the brand.	726	3.5207	1.47119
CE10	When I decide to buy or change a smartphone, this brand is one of the brands I will always choose.	726	3.6612	1.41940
Brand Value				
BV1	I consider myself brand loyal.	726	3.4711	1.32815
BV2	The brand would be my first choice.	726	3.6446	1.43662
BV3	In general, I believe that the brand is a high quality business/organization.	726	3.7934	1.30305
BV4	The brand competes with other brands.	726	3.7672	1.30340
BV5	It is worth the money and time I spend to buy the brand.	726	3.6226	1.28363
BV6	I can distinguish the brand among other brands.	726	3.9339	1.26971
BV7	I can quickly recognize the brand's logo.	726	4.0744	1.31306
BV8	Some characteristics/features of the brand come to mind quickly.	726	3.8512	1.29930

4.3. Structural Model and Hypotesis Testing

The study hypotheses were investigated using structural equation modeling. As a result of the analysis, necessary modifications were made and good fit values were obtained. To obtain good fit values, a total of 5 items, 3 from smartphone features, 1 from customer commitment, and 1 from brand

value, were removed. Table 7 shows the hypothesis test results of the study based on the path analysis results obtained using the Amos 22.0 statistical package application.

Figure 2. SEM Results

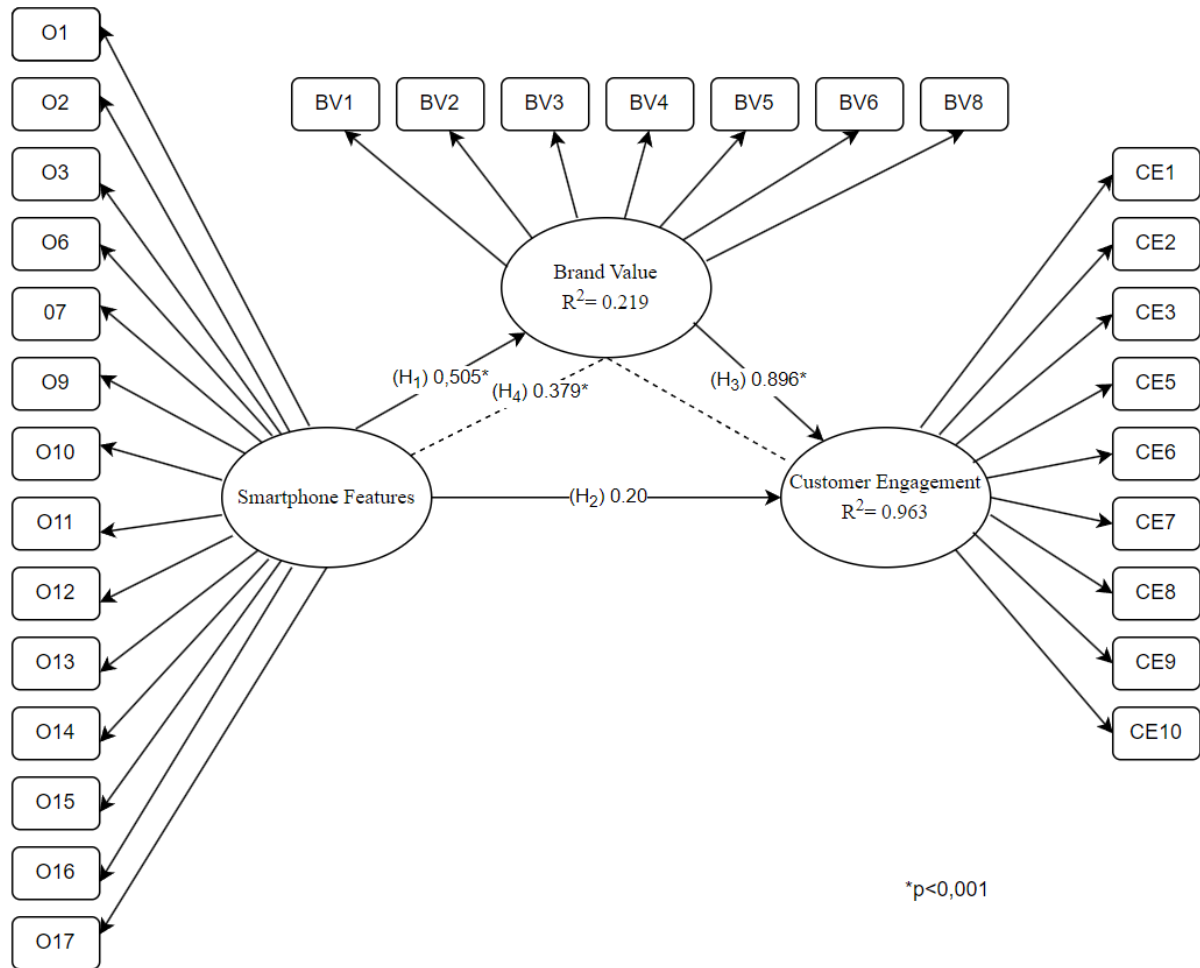


Table 7 presents the hypothesis test results of the research based on the path analysis conducted using the AMOS 22.0 statistical software.

Table 7. The Relationships between Smartphone Features, Customer Engagement and Brand Value

Hypothesis	β	S.E.	C.R.	p	R^2	Remarks
H ₁ Smartphone features- Brand Value	.505	.044	11.429	*	.219	Supported
H ₂ Smartphone features- Customer Engagement	.020	.021	.943	.345		-
H ₃ Brand Value-Customer Engagement	.896	0.55	16.222	*	.963	Supported

P<0.01

Hypothesis H₁ is supported ($\beta=.505$; $p<.01$), indicating that smartphone features significantly influence brand value. Similarly, hypothesis H₃ is supported ($\beta=.896$; $p<.01$), demonstrating that brand

value impacts customer commitment. In contrast, hypothesis H₂ is not supported, suggesting that smartphone features do not affect customer engagement.

4.4. Mediating Role

Three variables were included in the model to determine the mediating effect of brand value in the relationship between smartphone features and customer commitment. The significance of the indirect effects on the variables was examined by applying the Bootstrap method (Baron and Kenny, 1986). As a result of the analysis, it was concluded that the mediation effect of brand value is significant H₄ (p < .01; Confidence Interval: 379-536) (Table 8). Hypothesis H₄ is supported.

Table 8. Mediating Role of Brand Value

Hypothesis		Lower Bounds	Upper Bounds	p	Remarks
H ₄	Smartphone Features X Brand Value- Customer Engagement	.379	.536	*	Supported
P<0.01					

5. CONCLUSION

This study focuses on the need to provide deeper insights into the interaction of smartphone features with customer engagement and brand value. The study findings revealed that contrary to the literature, smartphone features do not directly affect customer engagement (Economides & Grousopoulou, 2009; Çakır & Demir, 2014; Arif et al., 2015; Cecere et al., 2015; Uludağ et al., 2018; Bacalhau, 2023). Hypothesis 1 proposed that smartphone features have a positive impact on brand value. The results support this hypothesis and show that the customer experience created by smartphone features has an increasing effect on brand value. This finding is in line with many studies in the literature and existing findings suggest that product features should be considered and continuously improved to build and sustain brand value (Buil et al., 2013; Christodoulides et al., 2015; Faircloth et al., 2001; Nguyen et al., 2013; Öcal, 2020; Tasci, 2021). Hypothesis 3 suggested that there is a positive relationship between brand value and customer engagement. The results of the study support this hypothesis and show that as customers perceive brand value positively in the products they purchase, their brand loyalty is positively affected (Too et al., 2001; Hollebeek, 2011; Vivek et al., 2012; So et al., 2016; Harrigan et al., 2017; Ou et al., 2020; Rasool et al., 2021; Albayrak et al., 2024). Our results also reveal that brand value plays a mediating role in the relationship between smartphone features and customer engagement. This finding suggests that the formation of brand value perception will increase customer engagement (Uludağ et al., 2018).

This study provides important insights for both academics and practitioners on how to increase brand value and strengthen customer engagement by enhancing smartphone features. In today's fiercely competitive environment, having a loyal consumer base offers businesses a real competitive advantage. This study proposes the adoption of a customer engagement orientation as a key strategy to build and

sustain brand value. Hence, a new understanding of brand value and customer engagement in the smartphone industry is presented. The findings of the study are also highly generalizable to service contexts such as retail, hospitality, tourism, and so on. This study makes a valuable contribution to the literature by identifying and empirically validating a model of brand value in the smartphone industry. In addition to its theoretical significance, this study also offers some important recommendations for marketing practitioners. With the growth and increasing competition in the smartphone industry, it has become increasingly critical for practitioners to know how to develop and maintain brand value and customer engagement. Accordingly, the study suggests that it is important for smartphone manufacturers to create better smartphone features and deliver them to customers with effective service quality to enhance customer engagement. It is also emphasized that businesses can increase customers' loyalty and perception of brand value by offering customized, interactive, and engaging features. This study acknowledges some limitations. First, while the current study investigates the relationship between customer engagement and brand value, there are other related constructs (e.g., brand loyalty, brand image, etc.) that could be used in future research to control for potential mediating effects. Finally, the study only addresses the positive aspects of customer engagement, and exploring the negative expressions of customer engagement across contexts could serve as another fruitful area of research.

For the study, ethics committee permission document dated March 25, 2024 and numbered 147/18 was obtained from the Süleyman Demirel University Ethics Committee.

The study has been crafted in adherence to the principles of research and publication ethics.

The author declares that there exists no financial conflict of interest involving any institution, organization, or individual(s) associated with the article.

The entire work was carried out by its only, stated author.

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