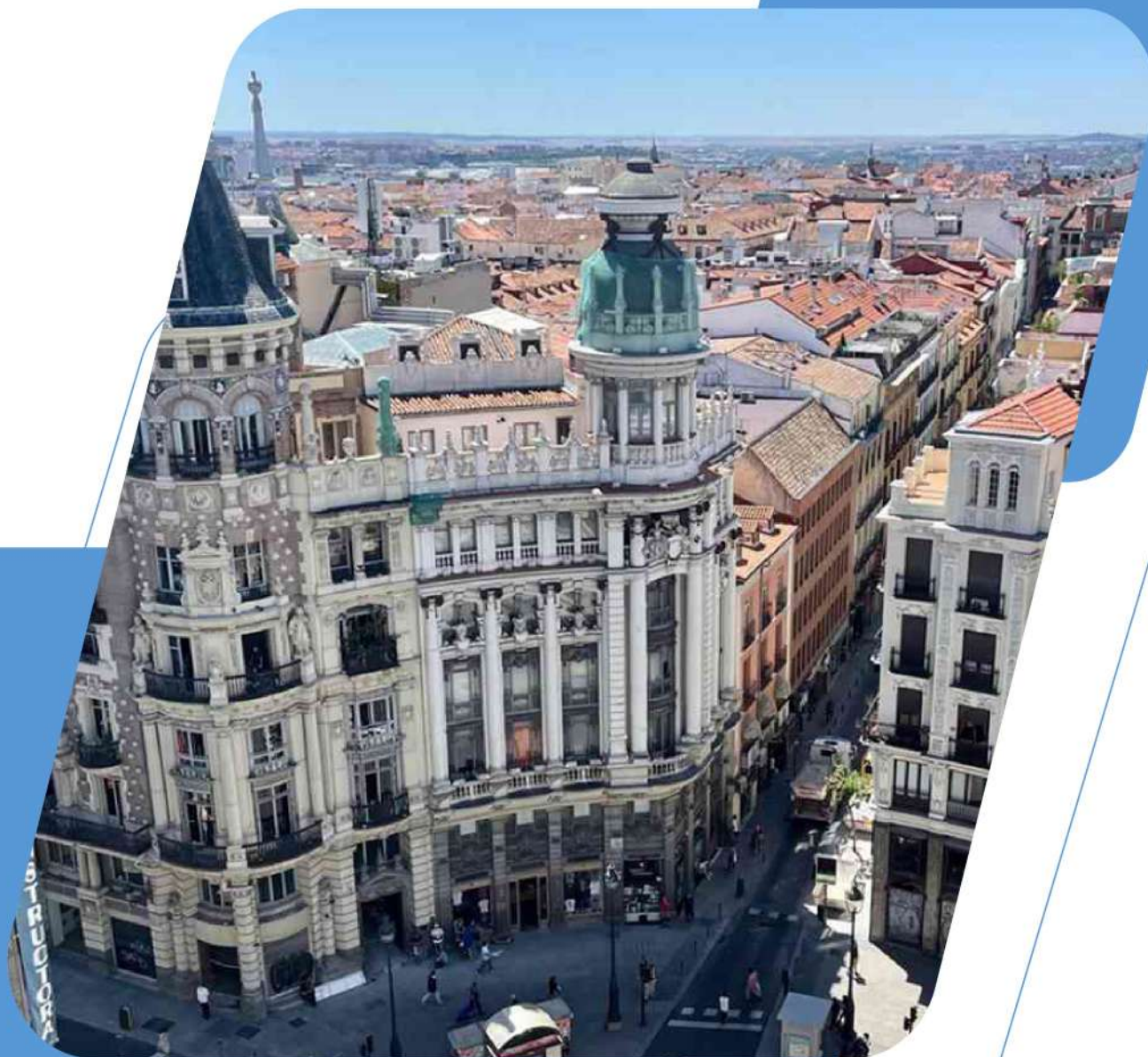




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Arts

ALEXANDER SCIABIN'S ROLU IN THE DEVELOPMENT OF THE RUSSIAN PIANISM SCHOOL

Humay Mansurova Saleh

*Azerbaijan State University of Culture and Arts, Faculty of Music,
Associate Professor of the Department of Instrumental Performance,
Honored teacher*

Abstract

The presented article is dedicated to the research of the creative path of the great Russian composer and pianist Alexander Scriabin. It turned out that despite the fact that Alexander Scriabin lived a short life, he left a great mark in the art of music. Although the composer wrote works in a number of genres, he achieved great achievements in the field of piano music. If you look at the creative path of the composer, you can see that his music consists only of piano and symphonic works. The composer does not stay away from piano music throughout his work, and his piano works constitute the largest part of the universal musical heritage. Thus, Alexander Scriabin's music is relevant even today with its depth and meaning.

Keywords: piano, Alexander Scriabin, mazurka, Russian composer, prelude, sonata, virtuoso, composer.

Introduction. The role of Alexander Scriabin in the history of music of the 19th and 20th centuries was undeniable, and it was of particular importance in the formation of the Russian school of pianism. S. Jafarova writes: "Alexander Scriabin is a famous pianist, composer and genius artist who worked at the end of the 19th century and the beginning of the 20th century. These are the words that come to mind when one thinks about the famous Russian musician". [2, p. 175

Scriabin's creativity can be divided into three stages: early years, the period of maturation of his creativity and the last years.

The early period covers the first decade of the composer's work, i.e. 1889-1899. During these years, the composer mainly created small works for the piano. It is known that in these years the foundation of the sonata genre was laid and concerts for piano and orchestra were created. The events of the period had an impact on Scriabin's creativity and were embodied in his works. In the preludes, nocturnes, impromptu and etudes he composed in these years, the events of the period are felt from an image-emotional point of view.

In 1892, he graduated from the Moscow Conservatory with a gold medal majoring in piano and composition, showing his innate talent.

In 1893, he composed his first piano sonata No. 1. In the sonata, it is possible to clearly see the characteristics of the composer's soul. Then, showing great interest in the prelude genre, he wrote the prelude in H (op. 2). This work, which is the first step in the field of prelude genre, further increases the composer's interest in the genre and brings him great fame. The prelude has a transparent-light, subtle-thought character, as if it has the characteristics of a lullaby. Here you can hear the lines of genres such as romance, nocturne and lullaby. One of the piano works composed in his youth is an impromptu in the form of a mazurka (op. 7, No. 2). For the first time in impromptu, it is possible to find leaps expressed by Scriabin's method.

In the composer's piano works of 1894-1896, performance issues are more prominent. Many piano works were created during these years: etudes (op. 8), preludes (op. 11, 13, 15, 17), impromptu (op. 10, 12, 14) and sonata-fantasia (op. 19). In each of these works, there is a further transparency of the mood characteristic of the composer's work: dramatic images, purposefulness, lyricism and sincerity.

With the emergence of the genre of prelude and etude, the instrumental style is refined, the imagination deepens in the genre of prelude instead of the genre of mazurka. The diverse and colorful nature of the works presents them in a more distinct and unique style. For example: Etude (No. 7, Op. 8) is gloomy and exciting, Etude (No. 12, Op. 8) willful, Prelude (Op. 11 is E flat) affirmative, Prelude (Op. 13, A minor) strange, Prelude (Op. 15, F sharp minor) whimsical, Prelude (Op. 11 is C) joyous, Prelude (Op. 11 is G) distinguished by its mobility. As you can see, each etude, prelude and other works differ from each other in terms of character. V. Dernova notes: "The artist who captures the pulse of life reveals the

complexity, thoughts and feelings of his time in his piano works and makes them sound relevant and convincing even today" [5, p. 47]

The years 1899-1903 were a period of transition in the composer's piano creation, during which he showed great interest in piano works as well as other genres. His works for piano include a series of mazurkas (op. 25), two preludes (op. 27) and a fantasia (op. 28). In this period, the composer's sonata No. 3 arouses greater interest. The sonata is composed in the classical three-part form and reflects the turbulent events in the composer's life. At the same time, during this period, he composed a programmatic symphonic work called "The Divine Poem", in which the emotionality characteristic of the composer's work is clearly manifested.

The middle period of Scriabin's creativity starts from 1903, and this period can be considered the period of the flourishing of the composer's creativity. In these years, interest in large genre works is increasing. Thus, the composer creates the symphonic poem "Ecstasy". In the second stage of his creativity, the composer almost rarely refers to works for the piano. However, in 1911-1914, the last period of piano creativity, works of various genres were created and enriched the repertoire of pianists and musicians. In these years, he composed five sonatas, the poem "Nocturne" (op. 61), the poem "Toward the Flame" (op. 72) and small works. In each of his works, the technical capabilities and rich timbre of the piano instrument are evident. Having achieved perfection in piano performance, the various methods expressed in the works are considered as innovations in the art of performance.

The series "Five Preludes" composed for piano (op. 74) is remembered for its harshness of sound, absence of lyricism, precision of expression lines.

The composer's piano sonata No. 3 has become very popular among music critics, performers, musicologists and listeners, causing great interest. One of the unique features of the sonata is explained by its four-part and relatively large volume. This sonata sounds like a symphony and stands out for its magnificence. The composer worked on this sonata for exactly five years: 1892-1897.

The first part of the sonata is composed in the form of a sonata allegro, and the main theme sounds tragic. All elements of the theme confirm the pathos of the struggle and the call for victory. The auxiliary theme is of great importance and differs from the auxiliary themes of the composer's other sonatas. For example: if we look at the auxiliary theme of sonata No. 2, the prominence of the lyrical style here attracts attention. In the auxiliary theme of sonata No. 3, along with lyrics, turbulences are heard. In the process of development of the connecting theme, a new motif is created, and this motif plays a special role in the combination of two sections. The theme itself creates a thumbnail form. As in Sonata No. 2, there is a contrast between the main and secondary themes. The appearance of a new motif in the complementary theme attracts attention. The scheme of the exposition can be shown as follows: A-B-C-B1-A1-C1.

Auxiliary and supplementary parts are relevant to the exposition as a whole. The composer follows the classical tradition here, but after the secondary theme there is an episode featuring an extremely important coda.

In Scriabin's work, sonata No. 3 is a four-part sequence, the elements characteristic of Russian music in the sonata attract attention. These elements are evident throughout the episodes. For example: in the rousing music of section I, the secondary theme, the reprise, etc.

The reprise section sounds affirmative and builds on the motifs of the main and secondary themes. Although the continuation of the movement with sixteenth notes creates a synthesized communication, the development does not stop there. As a result of the gradual progression during the performance of the theme in the lower register, the upper register is obtained.

As in Sonata No. 1, the final part of Sonata No. 3 is characterized by lines characteristic of the rondo form. The subject expresses the opposite of the struggle with images. In Sonata No. 1, all minor themes are united intonation. In sonata No. 3, dramatic and lyrical themes have an intonation relationship. The sonata ends with a magnificent coda.

A. Alekseyev writes: "Alexander Scriabin lived only 43 years and lived it as if in one breath. In the life and creativity of an artist, purposefulness and consistency have a special meaning. His works for the piano had a great influence on the formation of the world school of pianism" [1, p. 125].

A. Skryabin was considered a rare composer and pianist of his time. As a virtuoso pianist, he performed only his own compositions, thus confirming that he was a genius artist.

Thus, the great Russian composer and pianist of the 19th and 20th centuries, Alexander Scriabin, left a great mark on the art of music, despite his short life. His uniqueness as a musician and his bright individuality are known to everyone. Alexander Scriabin as an artist created a complete and complete image and reflected these images in all his works. If you look at the creative path of the composer, you

can see that his music consists only of piano and symphonic works. The composer does not stay away from piano music throughout his work, and his piano works constitute the largest part of the universal musical heritage.

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MODERN ASPECTS OF MUGHAM PERFORMANCE

Simare Cemaleddin Imanova

Associate prof.,

Azerbaijan State University of Culture and Art,

Faculty of Music, Department of Mugha, Doctor of Philosophy of Art Studies,

National Art Worker

MUĞAM PERFORMANSININ MODERN YÖNLERİ

Simare İmanova Cemaleddin kızı

Sanat Araştırmaları üzere Felsefe Doktoru,

Halk Sanatçısı, Müzik Fakültesi, Muğam Sanatı Bölümü

Azerbaycan Devlet Kültür ve Sanat Üniversitesi

Abstract

The presented article is devoted to the study of modern aspects of mugham performance. Modern aspects of mugham performance are enriched with new approaches and innovations while preserving traditional styles. Classical mugham styles are experienced through master-disciple relationships and educational programs. Mugham is combined with jazz, pop, rock and electronic music to create new styles. Mugham is reaching wider audiences through social media, studio technologies and virtual reality. Azerbaijani artists perform mugham at world festivals and concerts. Young artists are reviving this art in a modern way by performing mugham. Mugham is combined with theater, dance and other arts. These aspects allow mugham to develop in both classical and modern forms.

Özet

Sunulan makale, muğam icrasının modern yönlerinin araştırılmasına ayrılmıştır. Muğam icrasının modern yönleri, geleneksel üsluplar korunarak yeni yaklaşımlar ve yeniliklerle zenginleştirilmiştir. Klasik muğam tarzları usta-mürit ilişkileri ve eğitim programları aracılığıyla yaşanır. Muğam, caz, pop, rock ve elektronik müzikle bir araya getirilerek yeni tarzlar yaratılıyor. Sosyal medya, stüdyo teknolojileri ve sanal gerçeklik aracılığıyla muğam daha geniş kitlelere ulaştırılıyor. Azerbaycanlı sanatçılar dünya festivallerinde ve konserlerinde mugam sunuyorlar. Genç sanatçılar muğam icra ederek bu sanatı modern tarzda canlandırıyorlar. Muğam tiyatro, dans ve diğer sanatlarla birleştirilir. Bu yönler muğamın hem klasik hem de modern formlarda gelişmesini sağlar.

Keywords: mugham art, modern technologies, opera, vocal, tradition, jazz, culture, performance

Anahtar Kelimeler: muğam sanatı, modern teknolojiler, opera, vokal, gelenek, caz, kültür, performans.

GİRİŞ. Muğam, yaratılışının ilk zamanlarından başlayarak yüzyıllar boyunca devam eden kademeli bir gelişme ve evrim süreci sonucunda olgunlaşmış, şekillenmiş ve mükemmelleşmiştir. Muğam, en yüksek yaratıcı aşamaya getirilmiş halk vokal-enstrümantal kompozisyon örneğidir. Muğam'ın her bölümü, farklı sanatsal ifade araçlarıyla belirli bir sanatsal düşünceyi ifade eder. Muğamın her bir kısmı çoğu zaman bağımsız bir öze sahip olmasına ve ayrı ayrı icra edilebilmesine rağmen, organize edilmiş tek ana gelişim çizgisi, tutarlı mantıksal kurallara dayalı olarak bütünlüğünü ve bütünlüğünü kaybetmez. Mugam, ciddi içerikli müziklerin yanı sıra tüm müzikal kalıpları da bünyesinde barındırıyor. Muğam karmaşık fikir-duygusal anlam taşıyan, derin ve bitkin düşünmeyi, sanatsal heyecanı ve çeşitli müzikal imgelerin gelişimini ifade eden halk müziği dehasının harika bir ürünüdür.

Muğamlarımız, Azerbaycan'ın tarihi geçmişine dair en zengin ve nadide bilgilerle soydaşlarımızın bakış açısını şekillendirmekte, hatta Doğu milletlerinin sosyal ve siyasi hayatındaki tarihi olayların ortaya çıkarılmasında ve karşılaştırılmasında önemli bir rol oynamaktadır. Modern çağımızda muğam sanatı devletimiz tarafından oldukça takdir edilmektedir. 7 Kasım 2003 tarihinde Azerbaycan muğamı UNESCO tarafından "insanlığın sözlü ve manevi mirasının başyapıtlarından biri" ilan edilmiş ve anavatanının Azerbaycan olduğu kaydedilmiştir. Haydar Aliyev Vakfı 2005 yılından bu yana sürekli olarak "Azerbaycan

muğamları" projesini yürütmektedir. 24 muğam ustasının seslendirdiği "Karabağ Hanandeleri" müzik albümü, büyük ilgi gören ilk ve başarılı projedir. Vakfın 2008 yılında hazırladığı "Muğam Ansiklopedisi" kadim müzik mirasımızın korunması ve geliştirilmesi yolunda değerli bir yayın olarak değerlendirilmektedir. (7)

ƏSAS MƏTN. Azərbaycan'ın geleneksel müzik sanatının başlıca türlerinden biri olan muğam sanatı, zengin bir tarihi ve kültürel mirasa sahiptir. Azərbaycan muğam icrası, zengin tarihi ve kültürel temelleri ile dünya müzik sanatının eşsiz örneklerinden biridir. Bu gelişim sürecinde hem geleneksel tarzlar korunmuş hem de modern tarzlar ve yeniliklerle zenginleştirilmiştir. Orta Çağ'dan itibaren muğam icrası saray kültüründe, halk arasında ve dini törenlerde yaygınlaşmıştır. Muğamın ana unsurları (ayak, dal, sahne) çok eski çağlardan beri şekillenmiş ve nesilden nesile aktarılmıştır. Geçmişte muğam çalımı esas olarak usta-mürit ilişkileri yoluyla öğretiliyordu ve ustalar öğrencilerine muğamın inceliklerini öğretiyordu ve bu dönemde muğam çalımı daha çok sözlü geleneğe dayanıyordu.

Geçmişte muğam icracıları daha çok duygusal ifadenin, ses zenginliğinin ve teknik becerinin icranın odak noktası olduğu klasik tarzları tercih ediyorlardı. Muğam icrası çoğunlukla solo icra edilse de bazen toplulukla da icra edilmiştir. Bu dönemde muğam şarkıcıları ağırlıklı olarak halk arasında, düğünlerde, dini törenlerde ve saray konserlerinde sahne almışlardır. Sanatçıların temel amacı dinleyicileri duygusal olarak ifade etmek ve kültürel değerleri yaşatmaktır.

Modern zamanlarda muğam icrası farklı yönlerde gelişiyor, yeni tarzlar ve deneyimlerle zenginleşiyor. Günümüzde muğamın geleneksel formunun korunması ve kuşaktan kuşağa aktarılması için muğam okulları, usta-mürit ilişkileri ve geleneksel konser programları aracılığıyla bir takım girişimlerde bulunmaktadır. Muğam sanatı Azerbaycan kültürünün en değerli incilerinden biridir ve bu alanda çalışan pek çok müzikolog, araştırmacı ve bilim adamı görüşlerini dile getirmiş, muğamın teorik ve pratik yönlerini araştırmışlardır. Dahi Üzeyir Hacıbeyli, muğamın Azerbaycan müzik kültüründeki yeri ve önemini vurguladı ve teorik temellerini sistematize etti. Muğamın yapısını, anlarını ve icra tarzlarını inceledi. (1, s.3)

Şu anda muğam icracıları klasik muğamı caz, rock, pop, elektronik müzik ve diğer çağdaş türlerle birleştirme denemeleri yapıyor ve bu yaklaşım, muğamı daha geniş bir kitleye ulaştırmak ve gençler arasında popülerleştirmek için kullanılıyor. Örneğin Azerbaycanlı icracılar ve besteciler muğamı elektronik müzik aletleriyle birleştirerek yeni ve modern sesler yaratıyorlar. Muğam sanatçıları dünyanın farklı ülkelerinde düzenlenen festivallere, konserlere ve kültürel etkinliklere katılarak Azerbaycan'ın kültürel mirasını temsil etmektedir. Muğamın modern yorumları hazırlanarak uluslararası izleyicilere sunulmaktadır.

Eğitim sistemi içerisinde muğam icrasının geliştirilmesine yönelik özel programlar ve kurslar düzenlenmekte, genç neslin muğam sanatını öğrenmesi ve geliştirmesi için fırsatlar yaratılmaktadır. Modern zamanlarda, Azerbaycan'ın yüksek ve orta dereceli müzik okullarında muğam icrası yüksek düzeyde öğretilmektedir. Teknolojinin gelişmesiyle birlikte muğam icrası da yeni yöntemlerle sunulmakta, sanal gerçeklik, yapay zeka ve diğer yenilikçi teknolojiler aracılığıyla muğamın daha etkileşimli ve ilgi çekici bir şekilde sunulması mümkün olmaktadır. Muğam konserleri ve ustalık sınıflarının çevrimiçi platformlar aracılığıyla düzenlenmesiyle muğam, Azerbaycan'ın kültürel diplomasisinin önemli bir aracı haline geldi. Devlet düzeyinde düzenlenen kültürel etkinliklerde muğam icracıları Azerbaycan'ın kültürel zenginliğini sergiliyor.

Gençlerin muğama olan ilgisini artırmak için çeşitli proje ve girişimler hayata geçiriliyor. Örneğin gençlerin ilgisini çekmek amacıyla muğam yarışmaları, festivaller ve televizyon programları düzenlenmekte, sosyal medya platformlarında muğamla ilgili bilgi ve videolar paylaşılmaktadır. Muğam performansı, muğamın daha geniş bir kültürel bağlamda sunulmasına olanak tanıyan disiplinlerarası projeler oluşturmak için tiyatro, dans, resim ve diğer sanat formlarıyla birleştirilir. Günümüzde UNESCO'nun Somut Olmayan Kültürel Miras Listesi'nde yer alan muğam değerleri korunmakta ve tanıtılmaktadır.

Muğam icrası çeşitli müzik türleri ve teknolojilerle zenginleştirilmekte ve geniş yönlerde gelişmektedir. Bu gelişim, klasik ve geleneksel tarzların yanı sıra yeni yaklaşımları, denemeleri ve yenilikleri de içermektedir.

Klasik opera, muğam, gazel, romans ve diğer geleneksel ses tarzları modern çağda da önemini korumakta olup, bu tarzların eğitim sisteminde öğretilmesi ve icracılar tarafından sürdürülmesi önemli bir konudur. Modern muğam icracıları klasik eserleri kendi yorumlarıyla zenginleştirerek yeniden canlandırmaktadırlar. Bahsettiğimiz gibi günümüzde muğam icrası, modern müzik türleriyle (caz, pop, rock, hip-hop, elektronik müzik vb.) başarılı bir şekilde birleşerek daha geniş kitlelere ulaşmasını

sağlamaktadır.

Örneğin, muğam caz doğaçlama ve duygusal ifade zenginliğiyle öne çıkıyor ve daha dinamik ve enerjik bir performans tarzıyla karakterize ediliyor. Modern stüdyo teknolojileri (auto-tune, reverb, geciktirme vb.), sese benzersiz efektler veren ve yeni sesler yaratan muğam icrasına yeni bir renk getiriyor. Stüdyo performansı, canlı performansa göre daha fazla teknik beceri ve hassasiyet gerektirir. Çağdaş sanatçılar, alışılmadık performans teknikleri, farklı ses efektleri ve yeni ifade araçlarıyla mümkün olan sesin çeşitli olanaklarını keşfederek yeni stiller yaratıyorlar. Muğamın şiirsel ve duygusal yönlerini inceleyen tanınmış besteci Rahila Hasanova şöyle yazmıştır: "Kadim geleneklere sahip olan muğam sanatını modern müzik türleriyle bağdaştırmak mümkündür. Her durumda muğam icra tarzları dinleyicide çok hoş bir etki bırakır" (2, s. 17).

Muğam sanatının cazla sentezi hem Azerbaycan hem de dünya müzik sanatında ilginç ve yenilikçi bir yöndür. Bu sentez, geleneksel muğamın duygusal ve melodik zenginliğini cazın doğaçlama ve ritmik çeşitliliğiyle birleştirerek yeni ve benzersiz müzik formları yaratıyor. Muğam da caz da doğaçlamaya dayalıdır. Muğamcılar anlara dayalı doğaçlama yaparken, cazcılar zengin ve dinamik müzik yaratmak için iki tarzı birleştiren akorlara ve ritmik yapılara dayanarak doğaçlama yaparlar. Cazın karmaşık ritmik yapıları, muğamın klasik ritimleriyle birleşerek yeni ve ilginç ritmik kalıplar ortaya çıkar.

Muğam'ın anlar sistemi ve cazın armonik yapıları birleşerek benzersiz melodik çizgiler yaratıyor. Her iki tür de duygusal ifadelerle zenginleştirilmiştir, muğamın derin ve mistik atmosferi, cazın özgür ve enerjik anlatımıyla birleşerek dinleyicilerde güçlü bir duygusal etki bırakır.

Sovyet döneminde Azerbaycanlı besteciler muğamı klasik ve modern müzikle birleştirmeye başladılar. Örneğin Fikret Amirov'un "Muğam Senfonileri" bu yöndeki ilk girişimlerden biriydi. Bağımsızlık döneminde Azerbaycanlı icracılar ve besteciler muğamı cazla birleştirmek için daha çok denemeler yaptılar. Bu dönemde caz müzisyenleri muğam anlarına bestelerinde yer vermeye başladılar. Azerbaycanlı caz müzisyenleri muğamı dünya sahnelerinde sunarak bu sentezin uluslararası düzeyde tanınmasına yardımcı oldular.

Vagif Mustafazade Azerbaycan cazının en ünlü temsilcilerinden biridir. Muğamı cazla birleştirerek "caz-muğam" tarzını yarattı. Onun "Azerbaycan" ve "Gaitagi" gibi eserleri bu sentezin en güzel örnekleri arasındadır. Aziza Mustafazade caz ve muğamın sentezini de başarmış, icralarında muğamın duygusal derinliğini cazın özgür ifadesiyle birleştirmiştir. Shahin Novraslı, kendine özgü muğam ve caz sentezi tarzıyla tanınır. "Mugam" ve "Caz" adlı eserleri bu yönde önemli rol oynuyor. Muğam ve caz sentezinin hem Azerbaycan hem de dünya müzik sanatında geniş olanakları vardır. Bu sentez, geleneksel ve modern müzik tarzlarının başarılı kombinasyonunun mükemmel bir örneğidir ve gelecekte bu yönde daha fazla deney ve yeni çalışma bekleyebiliriz.

Muğam icracıları, sosyal medya platformları aracılığıyla sanatlarını daha geniş kitlelere ulaştırarak, yeni icracıların görünürlük kazanmaları ve kariyer geliştirmeleri için harika fırsatlar yaratmaktadır. Modern zamanlarda muğam icracıları farklı kültürlerin müziklerinden ilham alarak icralarını zenginleştirmekte, bu da dünya müziğinin sentezine ve yeni türlerin oluşmasına yol açmaktadır. Modern zamanlarda muğam icra eğitimi yöntemleri de gelişmektedir. Çevrimiçi dersler, ustalık sınıfları ve muğam uzmanlığı icracıların becerilerini geliştirir, muğam tekniklerindeki (diyafram nefesi, tonlama, diksiyon vb.) eğitimi daha da geliştirir. Ramiz Zohrabov bilimsel çalışmalarında muğamın tarihsel kökenlerini, teorik temellerini ve icra deneyimini araştırıyor ve muğamın Azerbaycan kültüründeki rolünü vurguluyor. (3, s. 71)

Modern muğam icracıları performans ifadelerini sadece sesle değil aynı zamanda vücut, yüz ifadeleri ve sahne hareketleri ile de zenginleştirerek, tiyatro konserleri ve görsel efektlerle icracıların sahne sunumunu daha ilgi çekici hale getirmektedir. Günümüzde muğam icracıları için sesin sağlığı ve korunması özel bir dikkat gerektirmektedir. Fikret Amirov, muğamın icra tekniklerini ve sesin duygusal ifade olanaklarını araştırarak muğamın psikolojik ve kültürel etkilerini ortaya çıkarıyor. C.Kuliyev şunları söylüyor: "Ünlü bestecimiz Fikret Amirov, muğamın senfonik müzikteki uygulamasını araştırarak ilk kez muğama dayalı senfonik muğamlar yarattı. Muğamın klasik müzikle sentezini analiz etti ve muğamın tüm türlerle sentezlendiğini kanıtladı." (4, s. 26)

Muğam sanatı üzerine yorum yapan müzikologlar ve akademisyenler, bu alanın teorik, pratik ve kültürel yönlerini kapsamlı bir şekilde araştırdılar. Eserleri muğamın tarihi, teorik temelleri, icra teknikleri ve kültürel önemi hakkında değerli bilgiler sunmaktadır. Bu kitap ve çalışmalar muğam sanatının korunması, geliştirilmesi ve tanıtılması açısından çok değerlidir.

Azerbaycan'ın geleneksel vokal sanatı olan muğam ve gazel, modern zamanlarda da önemini korumakta, yetenekli şarkıcılarımız muğamı dünya çapında temsil etmektedir. Caz müzisyenleri, muğam sanatını duygusal ifadeyle geliştirmek için doğaçlamalarında muğamları kullanırlar ve modern elektronik

müzik ile muğam performansının birleşimi yeni sesler ve tarzlar yaratır.

Azerbaycanlı muğam şarkıcıları dünyanın farklı ülkelerinde düzenlenen festival ve konserlere katılarak ülkenin kültürel mirasını temsil etmekte ve Azerbaycan kültürünü tanıtan programlarla muğam şarkıcılığı uluslararası alanda tanınmaktadır. Neriman Memmedov, muğamın tarihsel gelişimini ve modern zamanlardaki durumunu analiz ederek, muğamın kültürel ve sosyal önemini vurguluyor.

SONUC. *Böylece Azerbaycan muğam icrası geçmişten günümüze önemli değişim ve gelişim aşamaları geçirmiştir. Geçmişte klasik ve geleneksel tarzlar hakimken, günümüzde muğam modern müzik türleri, teknolojiler ve yenilikçi yaklaşımlarla zenginleştirilmiştir. Ancak geleneksel değerler korunuyor ve yaşatılıyor. Geçmişteki muğam icrasıyla bugünkü arasındaki temel fark, muğamın modern zamanlarda daha geniş kitlelere ulaşması ve uluslararası tanınırlık kazanmasıdır. Bu, Azerbaycan kültürünün dinamik gelişimini ve dünya kültür mirasına katkısını göstermektedir. Muğam icrasının modern zamanların klasik geleneklerini koruyarak yeni yönlerde gelişmesi, Azerbaycan kültürünün canlılığını ve dinamiklerini ortaya koymaktadır. Muğam sanatının modern yorumları ve yenilikçi yaklaşımları, bu kadim sanat formunun gelecek nesillere aktarılmasında önemli rol oynamaktadır.*

Modern muğam icrası, geleneksel üslupları koruyarak, yeni teknolojiler, deneyler ve kültürel çeşitlilikle zenginleşerek muğam sanatının daha dinamik ve ilgi çekici bir şekilde gelişmesini sağlar. Hem klasik hem de modern tarzların sentezi, muğam icrasının gelecekte geniş olanaklara sahip olacağını göstermektedir.

Azerbaycan'da muğam icrası, zengin kültürel miras ile modern yeniliklerin senteziyle gelişmektedir. Muğam icrasının yaygınlaşmasında geleneksel muğam, gazel, opera ve halk müziğinin yanı sıra modern müzik türleri ve teknolojileri de önemli rol oynamaktadır. Hem klasik hem de modern üslupların sentezi, Azerbaycan muğam icrasının gelecekte geniş fırsatlara sahip olacağını göstermektedir.

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Economic sciences

GLOBAL DYNAMICS OF SOCIALLY RESPONSIBLE INVESTING (SRI): ANALYSIS OF THE FACTORS MOTIVATING MNCS TO USE SRI STRATEGIES

Sevinc İbrahimova

Associate Professor of Odlar Yurdu University, Baku, Azerbaijan
<https://orcid.org/0009-0004-3670-2132>

Mayil Orujov

Honorary Professor of SMBS (Swiss Montreux Business School),
Odlar Yurdu University, Baku, Azerbaijan
<https://orcid.org/0009-0001-8177-3851>

Azer Orujov

Social Services Agency, Baku, Azerbaijan
<https://orcid.org/0009-0008-5638-8020>

Nermin Orujova

Social Services Agency, Baku, Azerbaijan
<https://orcid.org/0009-0007-1222-4238>

Abstract

The role and position of TNCs in achieving sustainable development of the global economy are currently at the center of scientific discourse, but at the same time, the emergence of new factors affecting the entire global economy entails the need for an in-depth analysis of new areas in the activities of TNCs, which include socially responsible investing (SRI). The article examines the global dynamics of SRI volumes; factors motivating TNCs to apply SRI practices; factors influencing the dynamics of SRI in Azerbaijan; the advantages of SRI practices in the activities of TNCs.

Keywords: TNC, socially responsible investment, SRI, investments, bonds, motivating factors

Introduction

Achieving sustainable development goals and ensuring "green" economic growth require the mobilization of significant financial resources. Governments of different countries expect an increase in the contribution of private sector assets and are taking a number of measures aimed at redistributing financial resources and using them to maintain the country's competitiveness and meet consumer demands. Current practice and dynamics of socially responsible investment (SRI) volumes show that it is necessary to search for new ways and apply new tools to achieve the UN Sustainable Development Goals (hereinafter referred to as the UN SDGs).

Currently, the development of the global economy is unstable, and the state of the global financial market is changeable and uncertain. In the current economic and geopolitical situation, one of the conditions for achieving the UN SDGs is to study the strategies and main areas of innovation activities of the main entities of the world economy, such as transnational corporations (hereinafter referred to as TNCs), whose activities can make a significant contribution to the socio-economic components of the sustainable development of the world economy. The role and position of TNCs in solving this problem are currently at the center of scientific discourse. However, in connection with the emergence of new factors influencing the global economy (its de-dollarization, the growth of the global debt burden, the increasing importance of the ever-growing contribution of developing countries to the global economy, climate change), an in-depth analysis of new areas in the activities of TNCs, which include socially responsible investing (SRI), is required.

Discussion

Research methods

The adoption of the Sustainable Development Goals by the UN General Assembly in 2015 became the starting point for achieving carbon neutrality and reducing global warming – Net Zero. It should be noted that the transition to a "green" economy, caused by changes occurring throughout the world, is a capital-intensive process (see Fig. 1).

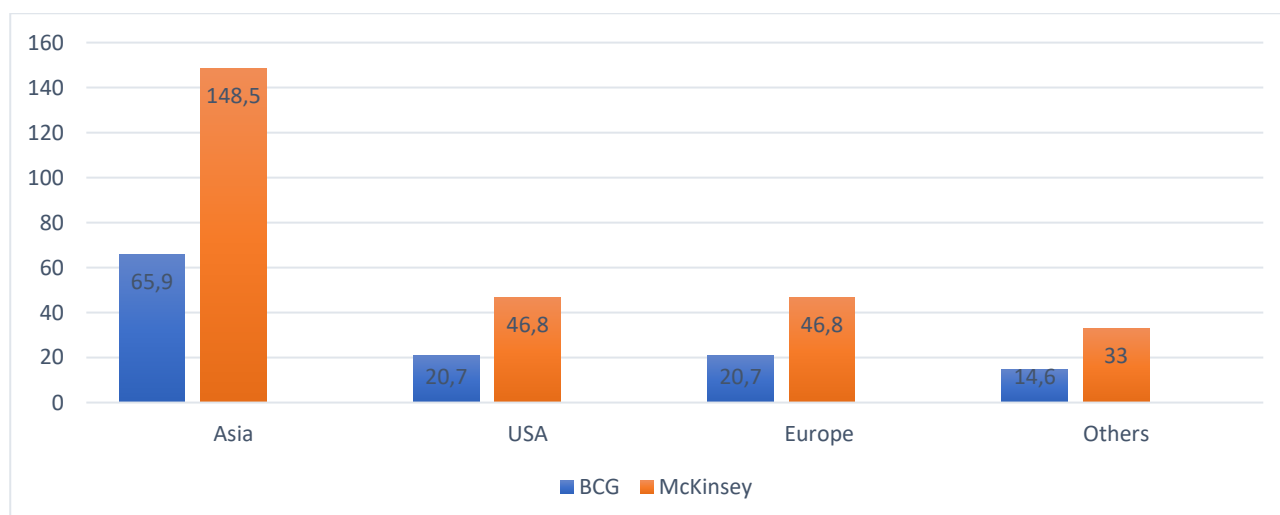


Fig. 1. Projected cumulative investment to achieve carbon neutrality by 2050, US\$ trillion

According to estimates by various economic institutions, capital of between \$120 trillion and \$290 trillion is needed to successfully achieve the UN SDGs, 20% of which will come from debt market financing [3].

In addition, it should be taken into account that in the context of recovery from the COVID-19 pandemic, geopolitical tensions, economic instability and the undermining of international cooperation, governments of many countries prefer the stability of economic development over a short-term period.

The first interest in the SRI topic in scientific research appeared in 1961, according to EBSCOhost databases. Over time, the agendas for sustainable development and the use of SRI tools will become increasingly "binding": for example, the development and introduction of regulatory requirements, the expansion of the theoretical base are expected. The Institutional Investors Group on Climate Change (IIGCC) announced its intention to develop principles of responsible asset management for bondholders [7]. To implement this plan, a special working group was created, which included nine institutional investors with combined assets under management of £2.66 trillion, including Allianz Global Investors, Neuberger Berman, Eurizon Capital and others [2]. In particular, in the debt markets there are no guidelines on socially responsible investing, as well as mechanisms for monitoring the responsibility of issuers in terms of SRI. With the increasing scale of SRI and related problems, it should be noted that investors often do not have internal departments specialized in managing these aspects. The new working group is designed to close this gap, acting in two main areas. The first area - interaction with bondholders - is aimed at developing guidelines and recommendations in the areas of socially responsible investing and interaction with issuers. Within the framework of this area, it is also envisaged to involve bondholders in such initiatives as Climate Action 100+ (a project of investors in the equity capital markets, which includes regular testing of large public companies for compliance with sustainable development goals). The second area of the working group's activities - financing structures and principles of new issues - involves the development and promotion of new instruments and best practices in the field of "green" financing, as well as the development of the ESG (Environment, Social, Governance) ecosystem of the debt market by expanding cooperation between issuers, banks and regulatory authorities.

A natural process of development of international economic relations is internationalization, which implies the implementation of one or another type of activity beyond national borders and assumes international interaction. The development of the internationalization process provides a number of advantages: the efficiency of using the resources of the global economy (labor, capital, information) increases, competition grows, and socio-economic development accelerates [1]. The goal of SRI, carried out by TNCs, is to support and promote sustainable development, preserve the environment and improve social justice. TNCs play an important role in the global economy: their activities can have a significant impact on the environment, social conditions and economic well-being of many countries and regions. The economic interest of TNCs in SRI is the pursuit of long-term profitability, which is the observance of the basic principle of relationships with stakeholders: the company must be responsible for developing relationships with them and maximizing capital intensity. Analyzing the dynamics of the issuance of ESG bonds, the author turned to the data of the Climate Bonds Initiative, according to which by October 1, 2024, the total volume of "environmental", "social", "transitional", SLB bonds exceeded 3.4 trillion US

dollars.

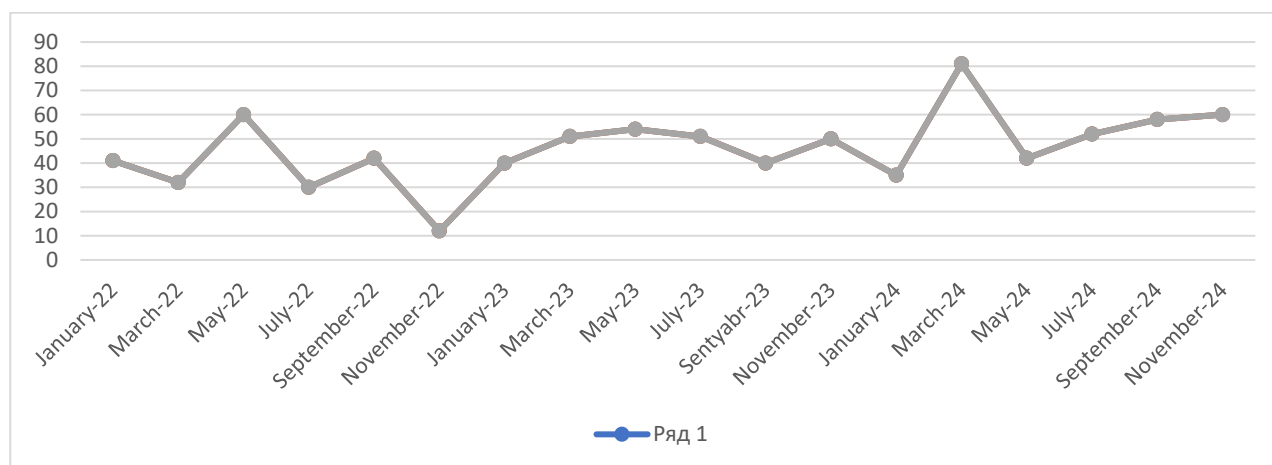


Рис. 2. Динамика SRI-облигаций за 2022–2024 гг., млрд долл. США

Figure 2 shows the dynamics of SRI bonds, according to the Climate Bonds Initiative verifier, over the 2022–2024 time horizon. Geopolitical and macroeconomic factors have left their mark on the volume of debt issuance in all “areas” of socially responsible investment, while the overall positive trend of socially responsible investment has been maintained. European countries are trying to find ways to minimize the impact of the special military operation in Ukraine on their economies. The European Commission is committed to issuing €250 billion in “green” bonds by the end of 2026, which best meet the requirements of the EU taxonomy in the field of “green” development. Another EU action that supports the positive trend is the issue of €100 billion in bonds for unemployment insurance purposes. It is assumed that the issuance of SRI bonds in the European Union will shift towards the social component to support projects created to help refugees from Ukraine.

The ESG bond market cannot develop only on the initiative of issuers and investors. The market for securities in the sustainable development sector requires government support measures. Organizations issuing securities in the CIS are demanding the abolition of mandatory reserves in the Central Bank for “green” and “social” bonds of which they are issuers, the abolition of taxation on income from the sale of such securities, and compensation for costs associated with the issue of ESG bonds. According to the Morningstar Rating Agency Review, almost a quarter of funds that claim to adhere to the principles of socially responsible investment in accordance with European rules do not deserve the “ESG” label. Australian supervisory authorities are introducing requirements for investment managers to combat greenwashing. It is necessary to select a benchmark index and use key performance indicators to measure progress in achieving the ESG goals of TNCs. Today, many companies doubt the need to invest in “green” and “social” projects, fearing a decrease in profitability.

Results

Financial market participants consider various indicators characterizing the state of the economy, including the dynamics of SRI bonds to analyze the process of sustainable socio-economic development. Currently, in Azerbaijan, modeling factors affecting SRI instruments is a hot topic. Further in the paper, an empirical study is presented using a correlation and multifactor regression model. The following factors were selected:

- “sustainability” factors in the form of the RSPP “Responsibility and Openness” index, the Dow Jones Sustainability World index, which includes the largest companies that comply with ESG principles;
- factors used in the electric power industry, in the form of a futures contract for oil (Brent) - about 5% is used, thermal coal (Coal Futures - (ARGUS-McCloskey)), shares of the largest installer of solar panels Sunrun Inc. The choice in favor of using multifactor linear regression is due to the achievement of homogeneity of variables, comparability of data. To select factors for obtaining high-quality econometric parameters during modeling, a test for multicollinearity was performed (see Table 1).

Table 1

Results of the analysis of selected factors for multicollinearity

	RSPP Index	Oil futures	Power coal	Dow Jones Sustainability Index	Solar panels
RSPP Index	1				
Oil futures	- 2,403	1			
Power coal	- 0,515	0,714	1		
Dow Jones Sustainability Index	0,476	0,040	-0,518	1	
Solar panels	0,478	-0,631	- 0,199	- 0,399	1

Based on the results of the analysis of the correlation matrix (see Table 1), the Brent factor was excluded modulo, since the value of the pair correlation coefficient with Coal Futures is higher than 0.7, which may lead to problems with the quality of the obtained coefficients. The Brent and Sunrun factors have a moderate inverse relationship. Based on the selected factors (see Table 2), a multiple regression equation was compiled for the SRI bonds indicator: $Y = 393.2546 - 0.02178X_1 - 0.3117X_2 + 0.03392X_3 - 5.9618X_4$.

Table 2

Selected data used in the calculation

Y (SRI bonds in Azerbaijan)	X1 (RSPP index)	X2 (energy coal)	X3 (Dow Jones Sustainability Index)	X4 (solar panels)
22,93	2530,81	69,35	3142,63	69,98
27,73	2748,53	70,25	3314,92	59,13
107,45	2997,32	122,3	3536,04	56,21
127,2	3145,66	233,6	3506,35	44,55
167,44	3044,59	136,75	3783,35	34,3
167,2	2287,97	265	3601,14	30,35
166,92	1815,29	367	3068,03	24,36
223,2	1584,95	328,5	2813,32	27,59
270,77	1763,29	227,9	3144,69	24,02
275,08	1906,44	138,3	3397	20,15
295,38	2128,71	115,59	3593,66	17,86
354,55	2398,05	117,55	3884,6	19,63
370,65	2383,05	117,55	3884,6	19,63
384,66	2579,78	119,75	4127,04	12,74

The constant shows that without taking into account the factors included in the calculation, the SRI bonds indicator in Russia would have amounted to 393.2546 billion rubles. With an increase in the RSPP "Responsibility and Openness" index quotes by 1, the SRI bond indicator in Russia decreases by 0.02178, which proves the caution of organizations towards the tightening of the regulatory environment. The Dow Jones Sustainability World index factor is the only one that indicates that with its increase by 1, the SRI bond indicator in Russia will increase by 0.03392.

The strongest influence is exerted by the factor Sunrun Inc. In order to assess the strength of the influence of factors on the result, the multiple correlation index was calculated ($R = 0.966$). Unlike the pair correlation coefficient, its values cannot take negative values ($0 < R < 1$). Therefore, multiple R does not show the direction of the relationship. The value of the coefficient indicates a strong relationship between the dynamics of SRI in Russia and the selected factors. The determination coefficient is at the level of 0.932 (the closer the coefficient to 1, the more the selected factors explain the variable Y (SRI bonds in Azerbaijan)).

The overall quality of the multiple regression equation was checked using Fisher's F -criterion. The significance level is determined at 0.05.

$$F_{\text{calculated}} = R^2 / (1 - R^2) * (n - m - 1) / m = 34.434.$$

$$F_{\text{tabular}} \text{ (with degrees of freedom } k_1 = 4; k_2 = n - m - 1 = 15 - 4 - 1 = 10) = 3.478.$$

Since the actual value of $F_{\text{calculated}} > F_{\text{tabular}}$, the coefficient determination is statistically significant and the regression equation is statistically reliable (i.e. the coefficients b_i ($b_1 = -0.02178$; $b_2 = -0.3117$; $b_3 = 0.03392$; $b_4 = -5.9618$) in the compiled regression equation are jointly significant). The calculated values for the dynamics of SRI bonds in Azerbaijan differ from the actual ones by approximately 36%.

Discussion

As the global community has come to understand the need to create a unified approach to accounting for socially responsible investing, including bond instruments, this responsibility has been

assigned to the International Capital Markets Association (ICMA) and the Climate Bonds Initiative (CBI). Thus, according to the standards developed by these international organizations, an important aspect of classifying bonds as "green" or "social" is their compliance with national or supranational taxonomies of "green", "social" or "transition" projects.

Australia has taken a significant step in the fight against climate change, proving that it is serious about reducing emissions and using the economic opportunities of affordable renewable energy. The Senate (the upper house of the Australian Parliament) passed the Climate Change Bill in its final reading on November 3, 2022, which enshrines the national target for reducing greenhouse gas emissions announced by the government on July 27, 2022, and a number of other steps. The policy measures immediately received investment support from the corporate sector. On the eve of the Senate vote, Ignacio Galan, the head of the Spanish multinational corporation Iberdrola, visited Australia and announced major investments in the renewable energy sector during meetings with local politicians. Iberdrola has already invested €2 billion in the development of renewable energy sources in Australia, and Galan said that the company is committed to investing another €2 to €3 billion, which will allow it to increase the capacity of renewable sources in Australia from the current 2,000 MW to 4,000 MW in the coming years. The company has formed its existing portfolio of capacities both through the purchase of existing companies and through investment in new projects.

In Azerbaijan, the practice of socially responsible investment is just beginning to develop. The starting point can be considered the development of the Moscow Exchange sector, which is responsible for projects in the field of ecology, environmental protection and socially significant projects. The government of Azerbaijan has also taken an active part in the development of the securities market. At the end of 2019, the Bank of Azerbaijan approved the Standards for the Issuance of Green and Social Bonds. Since November 2020, VEB.AR has been a methodological center for financial instruments in the field of socially responsible investing, and in 2021, a taxonomy was already developed that approves the criteria for compliance with green projects. Despite external factors, Azerbaijan recognizes the importance of the climate agenda and remains committed to the UN sustainable development goals: plans to achieve carbon neutrality by 2060 remain unchanged. Thus, in order to achieve the task of comparability of the level of implementation of socially responsible investing, development of an ESG rating system, implementation of best international practices, the Bank of Azerbaijan declares its continued participation in the work of international organizations. A number of Azerbaijani TNCs already voluntarily follow the designated concept and publish reports in the GRI format (for example, SOKAR, AZAL, NEKSEN). Thus, large companies improve their business reputation due to their special attention to the "green" and "social" agenda.

Conclusion

The desire to comply with legal and regulatory requirements is a key motivator for MNCs to actively implement socially responsible investing and deserves a closer look:

1. Failure to comply with social and environmental standards can lead to serious reputational risks. MNCs are well aware that public attention to these issues can lead to negative consequences, including a decrease in consumer and investor confidence.

2. Violation of regulatory requirements can lead to legal consequences, fines, and even suspension of MNC activities in some cases. This creates significant operational risks for MNCs.

3. MNCs operate in different countries where different ESG regulations may apply. Compliance with international standards, such as the GRI principles or ISO 26000 standards, can simplify management and ensure a uniform standard within the company.

4. Companies that neglect ESG principles should be prepared for problems in attracting and retaining international investment capital. 5. Incorporating socially responsible investment strategies into companies' activities is one of the possible sources of innovation, allowing for the development of new products, technologies and business models. This approach helps companies to become more competitive and to adapt to changing market demands and customer needs.

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THE ROLE OF FINANCIAL MARKETS IN THE CONTEXT OF GLOBAL ECONOMIC CHALLENGES

Leyli Melikova

Lecturer at Baku State University,
 Researcher at UNEC Karabakh Economic Research Centre
 6 Istiglaliyet Street, Baku, Azerbaijan
<https://orcid.org/0000-0002-2988-2284>

РОЛЬ ФИНАНСОВЫХ РЫНКОВ В КОНТЕКСТЕ ГЛОБАЛЬНЫХ ЭКОНОМИЧЕСКИХ ВЫЗОВОВ

Меликова Лейли

Преподаватель Бакинского Государственного Университета,
 Научный сотрудник Карабахского экономического исследовательского центра UNEC
 Улица Истиглалиет, 6, Баку, Азербайджан
<https://orcid.org/0000-0002-2988-2284>

Abstract

The article gives a brief information about 'Classification of financial markets'. Different approaches to the definition of the concept of 'financial market' are investigated. Financial markets represent a system of economic relations connected with the issue of securities, their placement, as well as acts of term purchase and sale of financial instruments (financial market commodities). From the point of view of classification, financial markets can be considered as a set of financial institutions and economic entities that issue and purchase financial instruments. Each financial institution is given certain powers to carry out a particular transaction with a certain set of financial instruments. The main objective of financial markets is to ensure efficient allocation of financial resources among the final consumers of society. The solution of this task is very difficult for both objective and subjective reasons, as it is complicated by the existing diametrically opposite interests of financial market participants and high risk of fulfilment of financial obligations. Taking into account all the above ideas, we can conclude that the basis of the financial market is the mechanism of capital redistribution between lenders and borrowers with the help of intermediaries on the basis of supply and demand.

Аннотация

В статье дана краткая информация о «Классификации финансовых рынков». Исследованы различные подходы к определению понятия «финансовый рынок». Экономике финансовые рынки представляют собой систему экономических отношений, связанных с эмиссией ценных бумаг, их размещением, а также актами срочной купли-продажи финансовых инструментов (товаров финансового рынка). С точки зрения классификации финансовые рынки можно рассматривать как совокупность финансовых институтов и хозяйствующих субъектов, осуществляющих эмиссию и покупку финансовых инструментов. Каждому финансовому институту предоставлены определенные полномочия по осуществлению той или иной сделки с определенным набором финансовых инструментов. Основная цель финансовых рынков — обеспечение эффективного распределения финансовых ресурсов среди конечных потребителей общества. Решение этой задачи весьма затруднительно как по объективным, так и по субъективным причинам, так как осложняется существующими диаметрально противоположными интересами участников финансового рынка и высоким риском исполнения финансовых обязательств. Принимая во внимание все перечисленные идеи, можно прийти к выводу, что основой финансового рынка является механизм перераспределения капитала между кредиторами и заемщиками с помощью посредников на основе спроса и предложения.

Keywords: global challenges, global markets, global financial markets, financial stability, financial problems.

Ключевые слова: глобальные вызовы, глобальные рынки, мировые финансовые рынки, финансовая стабильность, финансовые проблемы.

Анализ экономической литературы показывает, что термин «Глобализация» впервые в

истории был использован в исследовательской работе «Глобализация рынков» профессора Гарвардской школы бизнеса Т.Левитта, опубликованной в 1983 году. Автор определяет «глобализацию» как чисто рыночное явление, и подразумевает интеграцию ряда различных секторов рынка, уделяя основное внимание ТНК. В качестве альтернативы такому подходу немецкий социолог К. Оме в своей работе «Мир без границ» (1990) отметил масштабность указанного процесса и мнение о том, что он не связан только с рынком. Механизмы и стратегии экономического развития отдельных национальных экономик теряют смысл, начинают появляться «глобальные» фирмы (здесь автор напрямую имеет в виду транснациональные компании), которые считаются более эффективными и, если можно так выразиться, мощными игроками на мировом уровне [1; 2].

Финансовые рынки можно классифицировать по ряду признаков: 1. Финансовые рынки делятся на две группы по периоду инвестирования: денежный рынок и рынок капитала. На денежном рынке средства размещаются на один год, а на рынке капиталов — более чем на один год. 2. По организационной форме движения денег финансовый рынок делится на кредитный рынок, рынок ценных бумаг, рынок лизинговых услуг, страховой и валютный рынок. Хотя слитки и другие драгоценные металлы утратили свой денежный статус в современной денежной системе, их часто называют финансовым рынком — рынком драгоценных металлов. В пользу включения этого рынка в группу финансовых рынков свидетельствуют факты, что красные и платиновые металлы активно коллекционируются населением (оно хранит свои деньги дома, не помещая их в банк или сберегательную кассу), а центральные банки продолжают создавать большой объем красных резервов [2]. 3. По источникам средств финансовые рынки делятся на два типа. Группа делится на: 1) внутренние или национальные финансовые рынки. Ресурсы этих рынков базируются на внутренних ресурсах страны. В это время даже если и привлекаются ресурсы других стран, то их удельный вес невелик; 2) мировые финансовые рынки. Их ресурсы создаются за счет резидентов разных государств. 4. В силу участия посредников в исполнении контрактов финансовый рынок делится на рынок без участия посредников и рынок с участием профессиональных посредников. При этом выделяют трех основных продавцов и конечных потребителей финансовых ресурсов. Группа делится на: хозяйствующие субъекты - предприятия и организации; физическое лицо; государство. Купля-продажа финансовых ресурсов осуществляется двумя способами - минуя посредническое кольцо в виде финансовых посредников, они доставляются непосредственно от первичной продажи к конечным потребителям, реализуются через одного или нескольких финансовых посредников [4,5]. В настоящее время финансовыми посредниками могут выступать кредитные организации, профессиональные участники рынка ценных бумаг, лизинговые и факторинговые компании, страховые компании. 5. К структурам финансового рынка по признакам привлечения денежных средств относятся: рынок долга и кредита, рынок ценных бумаг и деривативов, рынок лизинговых и факторинговых услуг, рынок трастовых операций (в его денежной составляющей) и рынок страхования. 6. По уровню развития финансовые рынки делятся на развитые и развивающиеся (во многих случаях созданные или сформированные рынки называют развивающимися). Развивающийся мир был введен в обращение Международной финансовой корпорацией в середине 1980-х годов [5,6,7].

Существует несколько классификаций мировых финансовых рынков, основанных на разных критериях. В зависимости от объекта операций мировые финансовые рынки объединяют несколько взаимосвязанных сегментов. К ним относятся валютные рынки, рынки долгового капитала, фондовые и страховые рынки, рынки золота (таблица 1.1).

Национальные участники	Структура рынка	Международные участники
Корпорации	Валютные рынки, включая рынок евровалют	Международные корпорации, ТМК
Банки и специализированные кредитно-финансовые учреждения, включая страховые компании	Рынки долгового капитала: а) денежный рынок; б) рынок капитала; в) европейский рынок.	Международные банки, ТМБ, специализированные кредитные и финансовые учреждения, включая страховые компании
Фондовые и товарные биржи. Государство	Фондовые рынки	Крупнейшие фондовые и товарные биржи. Международные валютно-кредитные и финансовые учреждения

Развитые финансовые рынки имеют следующие характеристики:

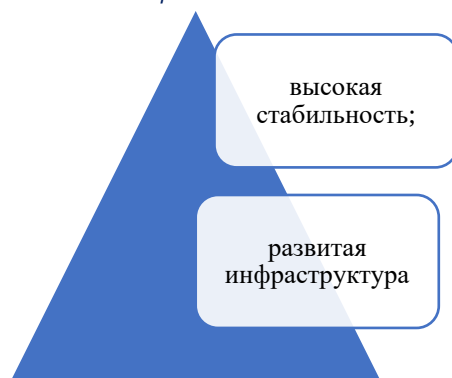


Рисунок 1. Постановка вопроса

Это совершенно нормально, включает в себя систему гарантий, страхование и защиту прав инвесторов, систему рейтинговых агентств и кредитных бюро, которые помогают снизить финансовый риск, систему аудиторов и оценок, которая обеспечивает прозрачность субъектов рынка, и систему бирж, которая создает и стимулирует новые рыночные коммуникации. развитие конкуренции [1]: развита законодательная база, регулирующая рыночные операции; наличие соответствующей информационной системы; система защиты интересов как продавцов, так и покупателей; большинство инструментов, работающих на рынке, отличаются высокой ликвидностью и надежностью; высокая надежность финансовых посредников, работающих на финансовом рынке; высокая стоимость финансовых ресурсов, предлагаемых для продажи и рыночных операций; высокая эффективность рынка; государственный контроль и регулирование финансового рынка на высоком уровне.

В настоящее время практически все развитые и развивающиеся кредитные организации в мире защищают интересы вкладчиков. Существуют две основные модели гарантирования вкладов. Первая — американская модель, где создается специальный государственный орган (или управляемый государством). Она предусматривает создание, участие кредитных организаций и финансирование системы гарантирования за счет банковских сборов и государственных средств. Вторая модель – немецкая модель. Управление системой гарантий осуществляет ассоциация кредитных организаций. Участие в ней формально обязательно, государственное финансирование отсутствует.

Американская система является старейшей. Федеральная корпорация по страхованию депозитов действует с момента своего создания и ориентирована на защиту вкладчиков коммерческих банков. В это же время была создана структура страхования депозитов в сберегательных банках (в 1980 году она была объединена с Федеральной корпорацией по страхованию депозитов). Страховым случаем считается банкротство банка или его закрытие государственным регулирующим органом. Страхование распространяется на вклады не только физических, но и юридических лиц (всех видов организаций). Часть средств, полученных за счет налога, перечисляется в федеральный бюджет. Страховым компаниям предоставлены широкие полномочия. Например, в США Федеральная корпорация по страхованию депозитов может потребовать изменения в руководстве банка или нарушения им банковских правил для исключения его из системы страхования (как и в других странах). В США нарушение договора страхования приостанавливается для всех внутренних вкладов, но продолжает влиять на старые вклады в Украине в течение двух лет [6].

По мере расширения деятельности финансовых инфраструктур достигается значительный прогресс в формировании и развитии финансового рынка. Таким образом, субъекты финансового рынка, выступающие посредниками между производственными предприятиями разных форм собственности, играют ведущую роль в управлении кругооборотом экономических ресурсов, способствуют получению коммерческих возможностей, создают условия для концентрации финансово-кредитных ресурсов и создают условия для их направления. из этих ресурсов в более полезные и производительные отрасли экономики. В экономической литературе нет единого мнения среди экономистов относительно классификации финансового рынка. По мнению группы ученых, финансовый рынок состоит только из кредитного и рынка ценных бумаг. Вторая группа ученых включает в состав финансового рынка фондовый рынок, денежный и фьючерсный рынок, или рынок фьючерсов. По мнению третьей группы ученых, когда мы говорим финансовый рынок, мы понимаем единство

денежного и кредитного рынков. В настоящее время к ним относятся рынок счетов, межбанковский рынок и валютный рынок как часть денежного рынка. При этом авторы этого мнения объединяют финансовый рынок с рынком ценных бумаг (фондов) и рынком средне- и долгосрочных банковских кредитов под понятием «рынок капиталов» [8,9].

Четвертая группа экономистов характеризует финансовый рынок по двум признакам: по обороту денежных средств и по результатам работы официального рынка. При классификации финансовых рынков по обороту денежных средств выделяют денежные рынки и рынки капиталов. Отнести финансовый рынок к организованному и независимому финансовому рынку можно в силу того, что на нем есть официальный рынок. К институциональным финансовым рынкам на денежном рынке эти экономисты относят коммерческие банки, а к институциональным финансовым рынкам на рынке капиталов – фондовые биржи. Для устойчивости экономики каждой страны в мировом контексте важно учитывать мировые финансовые процессы и диверсифицировать экономику [10; 11; 12; 13]. Кроме того, необходимо принимать дополнительные меры по повышению инвестиционной привлекательности и защите финансовой стабильности [14; 15; 16; 17]. Также следует серьезно рассмотреть вопрос расширения деятельности финансово-кредитных организаций [18; 19; 20; 21]. Необходимо объективно анализировать и оценивать потенциал регионов для формирования новых источников экономического роста и финансирования [22; 23]. В дополнение к ним должны быть реализованы проекты по ускорению инновационного развития [24]. В целом, возможности цифровых технологий должны быть максимально использованы для развития финансовых рынков [25; 26; 27].

Обобщая вышеизложенные идеи о классификации финансовых рынков, можно сделать вывод, что их несомненными потребностями являются: первая группа экономистов ограничивает финансовый рынок кредитным и рынком ценных бумаг и не включает денежный рынок, включающий валютный и межбанковский рынки; вторая группа экономистов финансирует состав финансового рынка. Однако, с одной стороны, фондовый рынок является постэмиссионной стадией рынка ценных бумаг, с другой стороны, в Азербайджане до сих пор нет фондового рынка, существует только первичный рынок (эмиссия) ценных бумаг; третья группа экономистов неверно включает в денежный рынок рынок счетов. Эти авторы также охватывают в учетный рынок казначейские и коммерческие векселя и другие краткосрочные обязательства. Но эти векселя должны принадлежать рынку ценных бумаг; четвертая группа экономистов не объясняет структуру финансового рынка и почему-то забывает о кредитном рынке; хотя пятая группа экономистов правильно объяснила структуру финансового рынка, они приравнивали рынок кредитного капитала к рынку банковских кредитов [28; 29; 30; 31].

Однако «рынок ссудного капитала» имеет более широкое значение, чем «рынок банковских кредитов», и больше соответствует понятию «финансовый рынок». В течение исследуемого 2015 года на мировых валютных рынках быстрыми темпами продолжалось дальнейшее укрепление доллара США по отношению к другим национальным валютам. Так, в течение года доллар США составил 11,1% по отношению к евро и 0,43% по отношению к японской иене, национальной валюте третьего основного экономического центра, 22,4% по отношению к российскому рублю, который подвергся жестким экономическим санкциям, и турецкой лире, которая недавно испытала серьезные внутренние политические потрясения. по сравнению с 25,4%.

Денежно-кредитная политика, реализуемая ФЭС, которая фактически выступает функцией мировых денег, в качестве основных факторов повышения стоимости доллара США, которая имеет очень серьезное влияние, на самом деле недостаточный или неравномерный экономический рост в торговых партнерах, кардинальное изменение географии инвестиционных потоков, и показаны высокочастотные и эффективные геополитические напряжения. Для более детального анализа наблюдаемой динамики на мировых валютных рынках уместно обратить внимание на следующий график. Так вот, и здесь основные тенденции проявляются отчетливо и оказывают весьма решающее влияние на будущее поведение конкретных национальных экономик (диаграмма 1).

Диаграмма 1

Мировые валютные рынки на примере курса доллара США



Источник: Центральный банк Азербайджана (www.cbag.az) и Bloomberg.

Учитывая все перечисленные идеи, можно прийти к выводу, что основой финансового рынка является механизм перераспределения капитала между кредиторами и заемщиками с помощью посредников на основе спроса и предложения.

В целом, долговой рынок, рынок капиталов, валютный рынок, денежный рынок, рынок страхования, фондовая биржа, рынок лизинга и т. д. являются составляющими финансового рынка. В зависимости от цели анализа, а также особенностей развития отдельных сегментов финансового рынка в той или иной стране, финансовый рынок.

При анализе финансовых рынков в странах, не завершивших свое экономическое развитие, заметно, что сбережения находятся на недостаточном уровне для продолжения и развития финансовых рынков, и в то же время количество инвесторов невелико. Поэтому уровни экономического развития оказывают влияние на структуру и механизм финансовых рынков. При этом с обеспечением экономического развития происходит рост сбережений и количества участников, и в связи с этим на финансовых рынках появляется динамизм.

С глобализацией международные финансовые рынки получают богатую альтернативу. Возможности, предлагаемые финансовыми рынками с точки зрения поиска долговых займов, показаны на следующем рисунке. Как видно из рисунка, когда лицо или учреждение, желающее занять на международных рынках, выбирает одну из возможностей прямого долга или акционерного капитала, оно принимает альтернативные возможности заимствования, предлагаемые ему в форме фиксированной или переменной валюты по его выбору. Как видно из рисунка ниже, кредитные, финансовые, торговые и управленческие услуги международной финансовой системы, а также дискреционные услуги предоставляют различные возможности и выгоды для инвесторов. Глобализация также позволяет инвестору в любой точке мира извлекать выгоду из всех этих услуг.

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THE IMPACT OF THE ECONOMY ON ENVIRONMENTAL POLICY: ON AZERBAIJAN'S ENERGY AND AGRICULTURE SECTORS

Xhuduyeva Shenay Bahram
Azerbaijan University of Technology

İQTİSADİYYATIN EKOLOJİ SİYASƏTƏ TƏSİRİ: AZƏRBAYCANIN ENERGETİKA VƏ KƏND TƏSƏRRÜFATI SEKTORLARI ÜZRƏ

Xuduyeva Shenay Bahram
Azərbaycan Texnologiya Universiteti

Abstract

This article investigates the impact of Azerbaijan's economy on environmental policy through the energy and agricultural sectors. It highlights the environmental damage caused by the oil and gas industry and the transition to renewable energy sources. The ecological challenges related to the use of chemical fertilizers in agriculture are discussed. The importance of environmental policies for sustainable development is emphasized. The Azerbaijani government is investing in green technologies. The sustainable development model is essential for future generations.

Xülasə

Bu məqalədə Azərbaycanın iqtisadiyyatının ekoloji siyasətə təsiri, energetika və kənd təsərrüfatı sektorları üzrə araşdırılır. Neft-qaz sektorunun ətraf mühitə mənfi təsirləri və bərpa olunan enerji mənbələrinə keçid müzakirə olunur. Kənd təsərrüfatında kimyəvi gübrələrin istifadəsi ilə bağlı ekoloji problemlər araşdırılır. Ekoloji siyasətlərin davamlı inkişaf üçün vacibliyi vurğulanır. Azərbaycan hökuməti yaşıl texnologiyalara sərmayələr yatırır. Davamlı inkişaf modeli gələcək nəsillər üçün vacibdir.

Аннотация

В статье рассматривается влияние экономики Азербайджана на экологическую политику через секторы энергетики и сельского хозяйства. Обсуждается вред, наносимый окружающей среде нефтегазовой отраслью, и переход на возобновляемые источники энергии. Изучаются экологические проблемы, связанные с использованием химических удобрений в сельском хозяйстве. Подчеркивается важность экологической политики для устойчивого развития. Правительство Азербайджана вкладывает средства в зеленые технологии. Модель устойчивого развития необходима для будущих поколений.

Keywords: oil and gas, renewable energy, agriculture, environmental policy, sustainable development, ecosystem.

Açar sözlər: neft-qaz, bərpa olunan enerji, kənd təsərrüfatı, ekoloji siyasət, davamlı inkişaf, ekosistem.

Ключевые слова: нефть и газ, возобновляемая энергия, сельское хозяйство, экологическая политика, устойчивое развитие, экосистема.

İqtisadi inkişaf əksər ölkələr üçün vacib bir prioritetdir. Lakin iqtisadiyyatın sürətli inkişafı ətraf mühitə mənfi təsir göstərir. Hazırda iqtisadiyyatın qarşısında duran əsas problemlərdən biri, davamlı inkişafın təmin edilməsi və təbii resursların səmərəli istifadəsidir. Ekoloji siyasətin əsas məqsədi iqtisadi fəaliyyətlərin ətraf mühitə vurduğu zərərləri minimuma endirməkdir. Azərbaycan, neft-qaz hasilatçısı bir ölkə olaraq, bu məsələdə xüsusilə həssasdır. Bu məqalədə Azərbaycanın iki əsas sektoru - energetika və kənd təsərrüfatı sahələri üzrə iqtisadiyyatın ekoloji təsirləri və bu sahələrdə ekoloji siyasətin rolu araşdırılacaq.

Azərbaycan iqtisadiyyatının dayaq nöqtələrindən biri olan neft-qaz sektoru, ölkəyə böyük gəlir gətirir. Lakin bu sektorun ətraf mühitə mənfi təsirləri də mövcuddur və bunu müzakirə etmək zəruridir. Neft Sənayesinin Ekoloji Təsirləri Azərbaycanın neft-qaz sənayesi iqtisadi inkişafın mühüm hissəsini təşkil etsə də, bu sektorun ətraf mühitə göstərdiyi təsirlər daha çox diqqət tələb edir. Xəzər dənizindəki neft sızmaları torpaq və suyun çirklənməsinə səbəb olur. Məsələn, 2021-ci ildə Dövlət Statistika

Komitəsinin məlumatına görə, sənaye sektorundan atmosfərə atılan karbon dioksid (CO_2) emissiyaları 35 milyon tona çatıb. Bu göstərici əsasən neft-qaz sənayesinin fəaliyyəti ilə bağlıdır. SOCAR-ın 2020-ci il hesabatına görə, neft hasilatı və emalı zamanı ətraf mühitə atılan tullantılar torpaqdakı bioloji müxtəlifliyi ciddi şəkildə məhv edir. Bu isə kənd təsərrüfatı sahələrində məhsuldarlığın azalmasına səbəb olur. Xəzər dənizində aparılan neft hasilatı isə su ekosistemlərinə ciddi təhlükə yaradır və bu təsirlərin qarşısını almaq üçün daha güclü tədbirlər görülməlidir.

Azərbaycanın iqtisadi inkişafının mühüm dayaqlarından biri olan neft-qaz sektoru, ölkəyə böyük miqdarda gəlir gətirir və dövlət büdcəsinin əsasını təşkil edir. Bununla belə, bu sektorun ətraf mühitə mənfi təsirləri də çox ciddidir və mütləq müzakirə olunmalıdır. Neft və qaz sənayesinin ekoloji təsirləri yalnız Azərbaycan üçün deyil, həm də bütün Xəzər regionu üçün böyük narahatlıq doğurur. İqtisadiyyatın bu əsas sahəsində fəaliyyətin davam etdirilməsi ölkənin iqtisadi rifahını artırırsa da, ətraf mühitə vurduğu zərərin miqyası dayanıqlı inkişafı təmin etmək üçün ciddi tədbirlər görülməsini zəruri edir.

Neft Sənayesinin Ekoloji Təsirləri- Neft və qaz sənayesi Azərbaycanda iqtisadiyyatın əsas tərkib hissəsidir və bu sahə milli gəlirin, ixracatın və məşğulluğun əsas mənbəyidir. Lakin, bu sənayenin fəaliyyətləri nəticəsində yaranan ətraf mühitə mənfi təsirləri daha çox diqqət tələb edir. Aşağıda neft sənayesinin ekoloji təsirlərini daha dərinlən araşdırıram:

Torpaq və suyun çirklənməsi- Xəzər dənizində həyata keçirilən neft hasilatı və nəqli torpaq və su resurslarının çirklənməsinə səbəb olur. Xəzər dənizi Azərbaycanın neft hasilatı sahəsində əsas mərkəzlərdən biridir. Lakin bu neft yataqlarında baş verən sızmalar dəniz suyu və sahilyanı torpaqların çirklənməsi ilə nəticələnir. Neft sızmaları torpağın üzərində yığılan neft və kimyəvi tullantılarla torpağın məhsuldarlığını azaldır. Torpaqda mikrofloranın məhvi ilə yanaşı, bu çirklənmə kənd təsərrüfatında məhsuldarlığın kəskin azalmasına səbəb olur. Belə ki, çirklənmiş torpaqlarda becərilən məhsulların keyfiyyəti aşağı düşür, bu isə insan sağlamlığına mənfi təsir göstərir. Xüsusilə kənd təsərrüfatı üçün yararlı torpaqlarda neftin və digər kimyəvi tullantıların miqdarının artması əkin sahələrinin məhsuldarlığını təhlükə altına alır.

Xəzər dənizindəki neft sızmaları su ekosistemlərini də ciddi şəkildə təhlükə altına alır. Dəniz suyu ilə neftin qarışması balıqların və digər su canlılarının həyatı fəaliyyətinə mənfi təsir göstərir. Suyu qarışan neft yalnız dəniz həyatını zərərli hala gətirmir, həm də çirklənmə nəticəsində balıqçılıq sənayesi ciddi zərərlə üzləşir. Xəzər dənizinin ekosistemi, suyun üzərində yığılan neft layları səbəbindən məhv olmaq təhlükəsi ilə üz-üzədir.

Karbon emissiyaları və iqlim dəyişikliyi- Neft və qaz sənayesinin ətraf mühitə vurduğu zərərlərdən biri də karbon emissiyaları ilə bağlıdır. Bu sənaye fəaliyyətləri nəticəsində atmosfərə atılan karbon dioksid (CO_2) və digər zərərli qazlar iqlim dəyişikliyinə sürətləndirir. Dövlət Statistika Komitəsinin 2021-ci il məlumatlarına görə, sənaye sektorundan atmosfərə buraxılan karbon qazı (CO_2) emissiyaları 35 milyon tona çatmışdır. Bu rəqəm əsasən neft və qaz sənayesinin fəaliyyətindən qaynaqlanır və Azərbaycanın iqlim dəyişikliyinə qarşı mübarizəsində böyük bir maneə yaradır.

SOCAR-ın (Azərbaycan Respublikası Dövlət Neft Şirkəti) 2020-ci il hesabatında qeyd olunur ki, neft hasilatı zamanı ətraf mühitə atılan tullantılar və tullantı qazlar yalnız torpaq və su resurslarına deyil, həm də atmosfərə ciddi ziyan vurur. Atmosfərə buraxılan zərərli qazlar havanın keyfiyyətini aşağı salır və həm ekoloji, həm də ictimai sağlamlıq problemləri yaradır. Bu isə tənəffüs yolları xəstəliklərinin artmasına, yerli əhəlinin sağlamlığının pisləşməsinə səbəb olur.

Atmosfərə buraxılan CO_2 və metan qazları (CH_4) global iqlim dəyişikliyinə başlıca səbəblərdən biridir. Neft hasilatı zamanı metan qazının sərbəst buraxılması istixana effektinə səbəb olur və iqlim dəyişikliyinə sürətlənməsinə gətirib çıxarır. Bu təsirlər uzunmüddətli perspektivdə yerli və global ekosistemlərə mənfi təsir göstərir və iqlim dəyişiklikləri ilə əlaqəli təbii fəlakətlərin artmasına şərait yaradır.

Su ekosistemlərinə təsir- Xəzər dənizində neft hasilatının artması yalnız suyun çirklənməsinə səbəb olmaqla qalmır, həm də su ekosistemlərini məhv edir. Xəzər dənizi neft hasilatında strateji əhəmiyyət daşıyan bir sahə olsa da, orada yaşayan dəniz canlılarının həyatı təhlükə altındadır. Neft sızmaları balıq populyasiyalarının azalmasına, balıqların kütləvi ölməsinə səbəb olur. Bu vəziyyət balıqçılıq sənayesinə də mənfi təsir göstərir. Balıq ehtiyatlarının azalması nəticəsində sahil bölgələrində balıqçılıqla məşğul olan əhəlinin gəlir mənbələri təhlükə altına düşür. Eyni zamanda, Xəzər dənizindəki su ekosistemlərinin məhv olması bioloji müxtəlifliyin azalmasına gətirib çıxarır.

Neft sızmalarının yaratdığı ən böyük problemlərdən biri də su ekosistemlərində zərərli kimyəvi maddələrin toplanmasıdır. Bu maddələr dəniz canlılarının həyat dövrlərini pozur və onların inkişafını ləngidir. Uzun müddətli sızmalar nəticəsində balıq və digər dəniz canlılarının populyasiyaları tükənmə

təhlükəsi ilə üzləşir, bu da regionun ekoloji balansına ciddi təsir edir.

Xəzər dənizi regionda neft hasilatı üzrə strateji əhəmiyyətə malikdir və burada həyata keçirilən hasilat əməliyyatları ölkə iqtisadiyyatı üçün böyük gəlir mənbəyi təşkil edir. Ancaq bu strateji əhəmiyyətə malik iqtisadi fəaliyyətin dəniz ekosistemlərinə vurduğu zərərlər həm qısamüddətli, həm də uzunmüddətli ekoloji problemlərə yol açır.

Neft sızmalarının balıq populyasiyalarına təsiri

Xəzər dənizində baş verən neft sızmaları nəticəsində balıqların həyatı fəaliyyəti ciddi şəkildə pozulur. Neftin su səthində yığılması və ya suyun içinə qarışması suyun oksigen səviyyəsinin azalmasına səbəb olur, bu isə balıq növlərinin kütləvi ölməsinə gətirib çıxarır. Suyun oksigen tərkibi azaldıqca, balıqlar və digər dəniz canlıları boğularaq məhv olur. Xüsusilə Xəzər dənizinə xas olan nərə balığı kimi nadir növlərin populyasiyası ciddi şəkildə azalır. Nərə balığının kürü istehsalı və balıqçılıq sənayesində vacib rolu olduğu üçün bu itkilər yalnız ekosistemə deyil, iqtisadi sektora da mənfi təsir göstərir. Nərə balığının kürüsündən alınan kürü (qara kürü) dəyərli bir ixrac məhsulu olsa da, populyasiyanın azalması nəticəsində bu sahədə fəaliyyət göstərən sənaye də təhlükə altındadır.

Balıqçılıq sənayesinə təsir

Xəzər dənizində neft sızmaları və ekosistemlərin məhv edilməsi sahil ərazilərində balıqçılıq sənayesinə ciddi zərbə vurur. Balıqçılıq sektoru bu bölgədə çoxsaylı insanların əsas dolanışiq mənbəyidir. Suyun çirklənməsi və balıq populyasiyasının azalması nəticəsində sahil bölgələrində balıqçılıqla məşğul olan əhəlinin gəlir mənbələri azalmağa başlayır. Balıq ehtiyatlarının azalması, balıq ovunun azalmasına səbəb olur və nəticədə balıqçılar üçün daha az gəlir gətirir. Bu proses uzun müddət davam etdikdə, sahil bölgələrindəki balıqçılıq sənayesi tənəzzülə uğrayır və yerli iqtisadiyyata mənfi təsir edir. Balıq populyasiyalarının bərpası üçün uzun müddət və çoxlu resurs tələb olunduğu üçün bu sənayedə itkilərin geri qaydışı çətin olur.

Bundan əlavə, balıqçılıq sənayesində fəaliyyət göstərən insanlar yalnız iqtisadi çətinliklərlə qarşılaşmır, həm də sosial-mədəni itkilərlə üzləşir. Bir çox sahil əhalisi nəsillər boyu balıqçılıqla məşğul olub və bu fəaliyyət onların həyat tərzinin ayrılmaz bir hissəsidir. Balıqçılığın azalması onların sosial-mədəni identifikasiyalarına da təsir göstərir.

Bioloji müxtəlifliyin azalması- Neft hasilatı yalnız su və torpaq ekosistemlərinə təsir etməklə kifayətlənmir, həm də bioloji müxtəlifliyi ciddi şəkildə məhv edir. SOCAR-ın apardığı tədqiqatlara görə, neft hasilatı zamanı ətraf mühitə buraxılan tullantılar torpaqdakı bioloji müxtəlifliyi azaldır. Bu təsir, xüsusilə kənd təsərrüfatı sahələrində daha aydın görünür. Torpaq məhv olduqca, torpağın məhsuldarlığı azalır və kənd təsərrüfatı məhsullarının keyfiyyəti pisləşir. Uzunmüddətli perspektivdə bu, Azərbaycanın kənd təsərrüfatı sektoruna mənfi təsir edir və ekoloji dayanıqlığı zəiflədir.

Bioloji müxtəlifliyin azalması yalnız kənd təsərrüfatı üçün deyil, həm də təbii ekosistemlərin dayanıqlığı üçün böyük təhlükə yaradır. Torpaq və su ehtiyatlarının məhvi yerli flora və faunanın tükənməsinə səbəb olur. Bu, global miqyasda Azərbaycanın ekoloji vəziyyətinə və təbii resurslarının davamlı istifadəsinə mənfi təsir göstərir.

Nəticə

Azərbaycanın neft-qaz sənayesi iqtisadiyyatın inkişafında mühüm rol oynasa da, bu sektorun ətraf mühitə vurduğu zərərlər dayanıqlı inkişaf modelinə keçidin vacibliyini göstərir. Neft sızmalarının, karbon emissiyalarının və digər ekoloji təsirlərin qarşısını almaq üçün daha güclü ekoloji siyasətlər həyata keçirilməli və təmiz enerji mənbələrinə keçid sürətləndirilməlidir. Azərbaycanın gələcək iqtisadi inkişafı yalnız ətraf mühitin qorunması və davamlı texnologiyaların tətbiqi ilə mümkün olacaqdır.

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IMPORTANT ASPECTS OF DEVELOPMENT OF THE KARABAKH ECONOMIC REGION**Aliyev Shafa***Doctor of Economic Sciences, Professor of Sumgait State University,
Head of the Center for Research of Karabakh Economy of UNEC – Azerbaijan State
University of Economics.**Baku, Republic of Azerbaijan*<https://orcid.org/0000-0002-4997-7563>**Abstract**

The article discusses the features and directions of economic development of the Karabakh economic region. The processes and tasks of the revival of the liberated territories are summarized. The possibilities of effective use of the resources of the Karabakh economic region are considered. The strategic role and features of the development of the city of Shusha in the region are analyzed. The economic characteristics of the construction of the cities of Aghdam and Fizuli are given. Proposals for the directions of development of the Karabakh economic region are prepared.

Keywords: Azerbaijan, Karabakh, Shusha, Aghdam, Fizuli, Karabakh economic region, Khankendi.

The Karabakh economic region was established by the decree of the President of Azerbaijan dated July 7, 2021 "On the new division of economic regions in the Republic of Azerbaijan". It should be noted that the Karabakh economic region is one of the 14 economic regions of Azerbaijan. This economic region includes the Agjabadi, Agdam, Barda, Fizuli, Khojaly, Khojavend, Shusha, Terter administrative districts and the city of Khankendi. Its total area is 7330 km². At the beginning of 2020, the population of the Karabakh economic region was 900.3 thousand people, which is about 9% of the total population of Azerbaijan [1]. Karabakh is an ancient land of Azerbaijan, where rare beauties and natural riches are located. The fundamental development of Karabakh was associated with the socio-economic development of the city of Shusha [2]. In the 19th century, trade and craft workshops were widely developed in Karabakh, and especially in Shusha. The city of Shusha was the intersection of caravan routes, and a caravanserai operated here. There were 500 looms in Shusha that produced various types of fabrics. Shusha carpets and silk products became popular [3]

In the 18th-19th centuries, the processes of formation and development of Karabakh accelerated. Thus, the intensive development of the city of Shusha during that period played a major role in the formation of statehood traditions in Azerbaijan, the preservation of national values and the development of the national spirit. On the other hand, Shusha is located in such a place. Here, both the charm of nature and the complex relief form a unity, and ultimately Shusha conceals the grandeur of a fortress. The formation and development of ancient artistic traditions, such as the work of silk workshops and the production of silk products, are also noted here. At the same time, such crafts as hat making, tailoring, and musical instrument making are also widespread [5]

During the Soviet Union, there was a process of armenization of Karabakh and weakening of the status of Shusha as the center of Karabakh. After Heydar Aliyev came to the leadership of the Communist Party of the Republic of Azerbaijan, a new stage of socio-economic development of the city of Shusha began [6]. Heydar Aliyev personally visited various administrative districts of Karabakh - Aghdam, Fizuli, Aghjabedi, Barda, mainly the city of Shusha, studied the problems on the spot and took the necessary measures to eliminate them. More funds were allocated for the improvement of Karabakh, and with large investments, the problems of creating important social and industrial territories were taken into account [7]. After the collapse of the former USSR, the Armenian armed forces, with the help and support of their external patrons, occupied most of the territory of Karabakh, including the city of Shusha. After the Great Karabakh Victory, which began on September 27, 2020 and lasted for 44 years, Azerbaijan began large-scale work towards the revival of the territories liberated from occupation and their restoration based on the most advanced technologies. The goal is to raise Karabakh and the adjacent territories to the highest standards of socio-economic development, to turn this region into a dynamically developing region with a high standard of living [4]. The restoration and development of the territories liberated from occupation based on systemic and comprehensive principles requires optimal approaches. The strategy of revival and development should reflect not only the best world practices, but also the

traditional features of development and potential of these territories. The main natural resources of the Karabakh economic region are polymetallic ores, various building materials (marble, cement raw materials, building stone), etc.

One of the most important and leading motivating moments in the liberation of our lands was the battle for Shusha. The liberation of Shusha from enemies entered world military history and was inscribed in golden letters in the annals of the heroism of the Azerbaijani army. After the victory, historical construction and revival were to follow. Currently, large-scale construction and revival projects are being implemented in Karabakh [8]. The main priorities are to accelerate the achievement of the goals of socio-economic development of the region and to ensure the return of former internally displaced persons to the city. At the same time, it is considered important to expand the scale of numerous construction projects carried out in the region. In addition to funds allocated from the state budget, it would be advisable to use investments from the private sector and foreign investors in these works in accordance with world experience [9].

It should be noted that there are sufficient resources to increase the investment attractiveness of the Karabakh economic region [10]. At the same time, the presence of priority tasks within the framework of the socio-economic development strategy for the period up to 2026 has created additional opportunities for faster restoration of the territories liberated from occupation. In addition, the "I State Program for the Great Return of the Territories Liberated from the Occupation of the Republic of Azerbaijan", approved by the decree of the President of the country dated November 16, provides for large-scale measures related to the revival of Shusha [11]. Acceleration of the settlement processes in the city of Shusha, Aghdam and Fizuli districts of the Karabakh economic region has been ensured. The first former internally displaced persons have already returned to the city of Fizuli, which is developing rapidly. In the cities of Shusha and Aghdam, residential areas and villages are being restored or rebuilt. Aghdam also has a modern industrial park, and the number of residents is increasing.

In addition to the development of the economy of Shusha and the unconditional consideration of traditional areas of employment, ensuring the development of crafts in accordance with the requirements of the time. It is also possible to note the potential for organizing the production and sale of souvenirs, works of art, musical instruments, goods and products from the activities of small and medium-sized businesses [12]. There are enough opportunities in the service sector, and the development of these areas can certainly accelerate the formation of the main areas of activity in the current economic construction of Shusha. [13]. In addition to modern hotels with wide opportunities, the effective use of real estate owned by small and medium businesses, the creation of guest houses, mini-hotels, motels and the construction of small catering facilities provide ample opportunities for the development of the Shusha service sector and provide additional incentives for its formation [14].

The main directions characteristic of the economic development of the Aghdam region are the key segments of agricultural activity, especially the potential associated with food wheat, the development of other types of agricultural products - viticulture, cotton growing, and at the same time, the availability of favorable conditions for the creation of processing industry complexes [15; 16; 17; 18; 19]. It can be concluded that Aghdam has a strong and promising economic potential based on such potential components and traditional areas of activity. In addition to the above-mentioned areas, there are also great opportunities for the development of other sectors of the economy, primarily the construction materials industry and tourism [20; 21; 22]. The strategic geographical location of Aghdam, its location at the junction with other regions, human resources and access to infrastructure significantly increase the opportunities to become the industrial center of Karabakh in the future [23; 24; 25]. Conceptual approaches related to the development of the city of Fizuli have been defined, the General Plan has been approved, which is currently being implemented. A number of important national and international road infrastructure projects, including the Fizuli-Hadrut highway and the Horadiz-Agbend railway line, are gaining momentum. The construction of the Ahmedbeyli-Fizuli-Shusha road is on schedule. The Fizuli substation has been commissioned to ensure uninterrupted power supply. The opening of the Fizuli International Airport, which is the air gateway to Karabakh, took place on October 26, 2021, with the participation of Turkish President R.T. Erdogan. The commissioning of the airport based on modern technologies can become the basis for the formation of an effective and multifunctional transport and logistics center in the region.

It is noteworthy that the return of former migrants to the city of Fizuli is being implemented intensively. In recent months, former internally displaced persons of Fizuli have been returning to their native lands. The city of Fizuli is developing day by day, modern urban development approaches are applied here. According to the General Plan of the city, Fizuli will be surrounded by three ring roads. At

the same time, the city of Fizuli will be developed based on the principles of a "smart city", digital and modern technologies. It is expected that by 2040, 50 thousand people will settle in the city of Fizuli, and mainly 4-5-storey residential buildings are being put into operation here. There will be 9 general and secondary education institutions, as well as 13 preschool educational institutions in the city of Fizuli. On August 23, 2023, the Uzbek state opened Secondary School No. 01 named after Mirza Ulugbey in the city of Fizuli, which meets modern world standards. In the near future, the construction of the Kurmangazy Children's Creativity Development Center in Fizuli will be completed by the Kazakhstani holding company BI-Group. 2023 is a particularly significant year for the Fizuli district and, first of all, the city of Fizuli, since Fizuli City Day was celebrated for the first time on October 17. On October 16, with the participation of President Ilham Aliyev, foundation laying ceremonies were held for a number of important settlements and complexes, as well as a modern sports complex and kindergarten, and the administrative building of the city of Fizuli. In the village of Gochakhmedly, it is planned to resettle 1,364 people, for which 341 private houses will be built. In the village of Juvarly, 21 residential buildings with a height of 2-4 floors and 291 private houses will be commissioned to resettle 1,697 people. In addition, a multifunctional residential area will be created in the second residential complex of the city of Fizuli, where it is planned to resettle 2,288 people in 653 apartments. A recreation area and other comfortable residential infrastructure will be formed on the territory of the district. In the third residential complex, which will be built in the city of Fizuli, 863 apartments will be built, designed for 3022 people. The foundation of a kindergarten for 240 children has also been laid in the city.

Khojavend is one of the regions liberated from occupation, distinguished by its natural resources, tourism resources and agricultural development resources. As a result of demining the territories in the Khojavend and Khojaly regions and the simultaneous resettlement of people there, the complete withdrawal of the Armenian armed forces from there and the restoration of stability in the peace processes in these regions in the near future, as a result of the establishment of the activities of state structures of Azerbaijan, new realities and opportunities will arise in the effective use of existing resources. In most segments of agriculture, opportunities are opening up for the creation of production and processing enterprises based on modern and "smart" technologies, as well as the effective use of tourism and recreation opportunities as the main areas of activity [26]. Currently, the Karabakh economic region includes a number of administrative-territorial units, the issues of the effective use of their resources remain relevant [27; 28; 29; 30; 31]. Taking into account the current potential and prospective opportunities, the structure of the Karabakh economic region can be summarized as follows: 1) agricultural areas and the agricultural sector in general; 2) agro-industrial complex; 3) services; 4) tourism sector; 5) construction materials production sector; 6) non-oil and gas industries; 7) electromechanical and instrument-making industry; 8) information and communication technologies and smart technologies; 9) transport and logistics sector; 10) cultural economy, etc. All this creates a serious basis for the socio-economic development of the region and creates favorable conditions for the dynamic development of the Karabakh economic region in the near future. In order to implement these measures and create an infrastructure for economic activity, there is a serious need to organize adequate banking infrastructure and provide financial services in the region [32; 33; 34]. In addition, the restoration of the city of Khankendi, as well as the cities of Khojaly and Khojavend for the Great Return of Former IDPs has begun. A new administrative district has been created in the region – Agdara district, etc.

In general, in order to accelerate the development of the Karabakh economic region and activate the Great Return, special attention should be paid to a number of issues:

- To accelerate the implementation of the 1st State Program related to the "Great Return", more effective mechanisms of public-private cooperation in this area are needed;

- In order to involve the natural resources of the Karabakh economic region in economic circulation, it may be useful to hold grant competitions for the creation of high-tech processing enterprises;

- Considering the important role of high and, above all, "smart" technologies in the processes of economic development of the region, it is proposed to open scientific and technological development and innovation centers in these areas, etc.

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Historical sciences

MARCH 31 - THE AZERBAIJANIS GENOCIDE DAY

Sevda Aghayeva Aydin

Azerbaijan State Pedagogical University, Baki, Azerbaijan
Philology Faculty, Senior Teacher of the Foreign Languages Centre
[ORCID: https://orcid.org/0000-0002-5615-692](https://orcid.org/0000-0002-5615-692)

31 MART – AZƏRBAYCANLILARIN SOYQIMI GÜNÜDÜR

Sevda Ağayeva Aydın

Azərbaycan Dövlət Pedaqoji Universiteti, Bakı, Azərbaycan
Filologiya fakültəsi, Xarici Dillər Mərkəzinin baş müəllimi
ORCID: <https://orcid.org/0000-0002-5615-692>

Abstract

Over the past two hundred years, along with many glorious pages, Azerbaijan's history has also been filled with tragedies, genocides, and calamities. One of these terrible events occurred in March-April 1918.

The March 31 genocide, which was committed against the Azerbaijan people and did not receive its political and legal assessment for many years, is one of the tragic pages of our history. This article provides detailed information about the genocide.

Xülasə

Son iki yüz ildə Azərbaycan tarixinə bir çox şanlı səhifələrlə yanaşı, faciələr və soyqırımları, müsibətlərlə dolu səhifələr də yazılıb. Bu dəhşətli hadisələrdən biri 1918-ci ilin mart-aprel aylarında yaşanmışdı.

Azərbaycan xalqına qarşı törədilmiş və uzun illər boyu öz siyasi-hüquqi qiymətini almamış 31 mart soyqırımı tariximizin faciəli səhifələrindən biridir. Bu məqalədə soyqırım haqqında ətraflı məlumat verilib.

Keywords: The March 31 genocide, the Azerbaijan people, great leader Heydar Aliyev, the Soviet regime, the Genocide of Azerbaijanis, a 44-day war, liberated territories, Martyrs, Victory Day, Patriotic War, Supreme Commander-in-Chief.

Açar sözlər: 31 mart soyqırımı, Azərbaycan xalqı, ulu öndər Heydər Əliyev, sovet rejimi, azərbaycanlıların soyqırımı, 44 günlük müharibə, işğaldan azad edilmiş ərazilər, şəhidlər, Qələbə günü, Vətən müharibəsi, Ali Baş Komandan.

Introduction

"Qarşımızda duran əsas vəzifələrdən biri xalqımıza qarşı həyata keçirilən soyqırımı haqqında indiki və gələcək nəsillərdə möhkəm milli yaddaş formalaşdırmaq, bu faciələrə bütün dünyada siyasi və hüquqi qiymət verilməsinə nail olmaq, onun ağır nəticələrinin aradan qaldırılmasına və bir daha belə halların təkrar olunmamasına çalışmaqdır. Bunun üçün isə yalnız möhkəm və yenilməz milli birlik nümayiş etdirməliyik".

Heydər Əliyev, Ümummilli Liderimiz

"One of the main tasks facing us is to form a strong national memory in the present and future generations about the genocide committed against our people, to achieve a political and legal assessment of these tragedies all over the world, to eliminate its grave consequences and to try to prevent such cases from happening again. For this, we must demonstrate only strong and invincible national unity."

Heydar Aliyev, Our National Leader

One of the most terrible tragedies inflicted on the Azerbaijani people, the March genocide of 1918, due to its cruelty and scale, is one of the bloodiest tragedies in the history of Azerbaijan and in the history of mankind, too. (1)

Although there were constant attempts to erase the blood memory of the people for 70 years

during the Soviet regime, this was not possible and finally, the moment of truth arrived.

After Azerbaijan regained its independence, it became possible to present an objective picture of the historical past of our people. The truths which were kept secret and banned for many years are being revealed individually. The political and legal assessment of the acts of genocide by the Decree of the great leader Heydar Aliyev "On the Genocide of Azerbaijanis" dated March 26, 1998, gave impetus to the research carried out in this field and to the increased efforts to uncover the truth. March 31 was declared the Day of the Genocide of Azerbaijanis to commemorate all the genocidal tragedies committed against the Azerbaijani people.

As a result of the genocide committed against the Azerbaijanis by armed groups of Armenian Dashnaks and their supporters in Baki and various regions of the Baku province, as well as in Shamakhi, Guba, Khachmaz, Lankaran, Hajigabul, Salyan, Kurdamir and other territories, tens of thousands of civilians were killed precisely because of their ethnic and religious affiliation, settlements were destroyed, cultural monuments, mosques and cemeteries were razed to the ground.

The March genocides of 1918, due to their cruelty and scale, are one of the bloodiest tragedies not



only in the history of Azerbaijan but also in the history of mankind. Taking advantage of the opportunity at their disposal, the Armenian executioners massively murdered civilians, without mentioning children, the elderly, or women. Along with tens of thousands of Azerbaijanis, thousands of Lezgi, Jewish, Russian, Avar and Talysh people were put to the sword, bayoneted and burned alive. They destroyed national architectural gems, schools, hospitals, mosques and cultural monuments. They turned a large part of Baku into ruins. (4)

Between March 30 and April 3, 1918, the Baki Soviet and Dashnak Armenian armed groups brutally massacred Azerbaijanis in Baku city and various regions of Baki province, as well as in Shamakhi, Guba, Khachmaz, Lankaran, Hajigabul, Salyan, Zangazur, Garabakh, Nakhchivan, Ganja and other territories. According to official sources, as a result of this genocide, about 12 thousand Azerbaijanis were mercilessly killed, and tens of thousands of people went missing.

A German with the surname Kulner, who witnessed those terrible days, wrote the following about the events in Baki in 1925: "Armenians entered Muslim (Azerbaijani) neighbourhoods and killed everyone, dismembered them with swords and pierced them with bayonets. A few days after the massacre, 87 Azerbaijani bodies were pulled out of a pit with their ears and noses cut off, their bellies torn open, and their genitals chopped off. The impalement of young women alive on walls and the burning of the city hospital where two thousand people were seeking refuge from the Armenian attack are among these horrific facts."

American agronomist Leonard Ramsden Hartill wrote a book titled "Inside the Events of 1918"/ "Men are Like That" based on the memoirs of Armenian officer Hovhannes Apresyan, who was one of the active participants in the massacre of Azerbaijanis in the Iravan province, Sharur-Deralayaz, Surmeli, Kars and other areas. During a conversation with the author of the book, Hovhannes Apresyan noted that they achieved their goals with the help of Armenians, English and Russians and stated that twenty-five thousand Azerbaijanis were killed during the March massacre in Baki alone.

The Menshevik newspaper "Nash Golos" described those days as follows: "Everywhere is full of corpses - burnt, mutilated, disfigured corpses..."

A.Y. Kluge, a German who witnessed those terrible days, wrote the following about the events in Baki: The Armenians showed no mercy to children, they showed no mercy to the elderly. (5)

M. A. Rasolzadeh wrote, referring to A.Y. Kluge: "The photos that Kluge and other foreigners took as a memory of those days and that are available today reflect very tragic scenes. On a pile of dead boys and girls, old shepherd dogs are gnawing at these innocent puppies... A naked woman is lying on the ground, dead... a live puppy is sucking the dried breast of this dead body..."

More than 12,000 people, mostly civilians and mainly Muslims, were brutally murdered in one week in Baku alone. The Bolshevik-Dashnak groups did not even allow Azerbaijanis to bury their dead relatives. They threw the bodies into burning buildings, into wells and into the sea. The establishment of full power in Baki by the Baki Soviet, headed by Shaumyan, did not allow an exact number of victims to be calculated. However, according to the writings of the Iranian consul in Baki, Mohammad Said-ol Vesara Maraghi, a special commission he had created alone collected and buried the bodies of more than 5,000

Muslims from the streets and courtyards of Baki. (4)

N. Narimanov wrote about the Shamakhi massacre: "The armed groups of T. Amirov and S. Lalayev, who were previously in Baki, killed all Azerbaijanis, regardless of age and gender. They committed a crime never seen before in the world, they bayoneted and sworded children, gathered people in a mosque, doused them with kerosene and set them on fire. It became clear to me that the Soviet government in Baki was dependent on the Dashnaks. It is also clear that after so much oppression of the Azerbaijan population by Armenian gangs, the Azerbaijani proletariat had the right to turn away from the Soviet government, to come under the protection of its bourgeoisie and to expect help from it and Turkiye." (4)

To give you an idea of the horror of these events, the materials of the Extraordinary Investigation Commission of the government of the Azerbaijan Democratic Republic, which existed in 1918-1920 indicate that:

In March-April 1918 up to 8,000 civilians were killed in Shamakhi. Most cultural monuments, including the Shamakhi Juma Mosque were burned and demolished.

28 villages in the Javanshir district and 17 villages in the Jabrayil district were completely burned down and their populations were destroyed.

On April 29, 1918 a 3,000-strong Azerbaijan refugee camp, consisting mainly of women, children and the elderly was ambushed near Gyumri and exterminated to the last man.

Armenian armed groups destroyed 115 Azerbaijan villages in the Zangazur district, killing 3257 men, 2276 women and 2,196 children. In total 10068 Azerbaijanis were killed or maimed in this district and 50,000 Azerbaijanis became refugees.

135,000 Azerbaijanis living in 199 villages in the Iravan province were killed and the villages were razed to the ground. Armenian armed groups later marched to Garabakh and between 1918 and 1920, 150 villages were destroyed and their populations exterminated in the mountainous part of Garabakh. (2)

After the establishment of the Azerbaijan Democratic Republic, the Council of Ministers adopted a decision on the establishment of an Extraordinary Commission of Inquiry on July 15, 1918, to investigate this tragedy. The Commission investigated the March Genocide - initially, the atrocities in Shamakhi, and the grave crimes committed by Armenians in the territory of the Iravan province. A special body was established under the Ministry of Foreign Affairs to convey these truths to the world community. March 31 was declared a day of national mourning by the Azerbaijan Democratic Republic. Thus, for the first time in history, an attempt was made to give a political assessment of the genocide committed against Azerbaijanis and the occupation of our lands, which had lasted for more than a century. After the collapse of the Azerbaijan Democratic Republic, the work was left unfinished.

Although the policy of genocide against Azerbaijanis has a long history, the true truth about it was brought to the public thanks to the determination of our national leader Heydar Aliyev. The genocide received its legal and political significance only after the Decree of our great leader dated March 26, 1998. Since then March 31 has been celebrated at the state level as the Day of the Genocide of Azerbaijanis, drawing the attention of the world community to this tragedy.

In that historic Decree of the great leader Heydar Aliyev, the separate stages of the deliberate and planned genocidal policy carried out by Armenians against Azerbaijanis are brought to attention. It is noted that the Republic of Azerbaijan, as the successor of the Azerbaijan Democratic Republic, today accepts the duty of giving a political assessment to the events of the genocide as a verdict of history, as a logical continuation of the decisions that it could not implement to the end. (3)

The policy of genocide was carried out in different forms at different times, accompanied by mass murders and military operations. The forced change of the demographic situation in Garabakh and Zangazur at the expense of Armenians resettled from Iran and the Ottoman Empire in the first half of the 19th century the mass massacres of the Azerbaijan population in 1905 and 1918, the establishment of the Armenian state in the historical lands of Azerbaijan in 1918 and the concession of the city of Iravan, one of the most important cultural centres of Azerbaijan, as its capital to Armenia, the transfer of Zangazur to the Armenians by the Soviet government in the 1920s, the deportation of hundreds of thousands of Azerbaijanis from their ancestral lands in the territory of present-day Armenia in 1948-1953 and other facts are tragic and bloody pages of the history of genocide.

Aggressive Armenian nationalists have been implementing a genocidal policy against our people for nearly two hundred years. With the aim of expelling Azerbaijanis from their historical lands and creating a mythical "Greater Armenia" in these territories with the help of their foreign supporters, Azerbaijan and Turkish peoples have been subjected to systematic ideological and military aggression by Armenians for decades. The centuries-old history of our people has been grossly falsified, Armenians have

appropriated our cultural monuments and toponyms. (1)

Armenian genocide against Azerbaijanis was repeated at the end of the 20th century. In February 1992, Armenians inflicted an unprecedented massacre on the population of the city of Khojaly.

This bloody tragedy resulted in the extermination, capture and razing of thousands of Azerbaijanis. As a result of the military aggression of the Republic of Armenia against the Republic of Azerbaijan which made the policy of state terror its main goal and the adventurist action launched by Armenian terrorist-separatist armed groups in the occupied territories of our country in Garabakh the ancient and historical land of Azerbaijan, the Azerbaijanis were subjected to genocide, massacres and the atrocities of ethnic cleansing.

Thousands of our citizens were martyred during the occupation of 20 per cent of our territory by the Armenian armed forces. (2)

As the pages of history turn over the past 200 years, new facts and gruesome scenes of Armenian atrocities come to light. Recently, searches for clarification of information have been expanded. Irrefutable archival documents and numerous pieces of evidence confirming the genocides are being discovered.

In recent years, mass graves, which are evidence of the genocide have been discovered in some areas of Azerbaijan. One of these is a mass grave accidentally discovered in 2007 during excavations for construction purposes in the city of Guba. To inform the world community about the criminal acts committed by Armenian nationalists throughout the country in 1918 in connection with territorial claims against Azerbaijan, to protect the national memory of future generations of the Azerbaijan people and



to perpetuate the memory of the victims of the genocide, the "Guba Genocide Memorial Complex" was built near the mass grave discovered by the Heydar Aliyev Foundation based on the order of the President of the Republic of Azerbaijan Ilham Aliyev dated December 30, 2009. This museum-monument, which opened on September 18, 2013, is a clear example of the fact that not only the Guba massacres but also the tragedies committed by Armenian national-military units against the Azerbaijani-Muslim population throughout the territory of Azerbaijan in 1918 are not forgotten by the Azerbaijan people today. The memory of the victims of the genocide is cherished.

Although 2020 was a difficult year for the whole world, it was remembered for successes in political, diplomatic, and military areas in Azerbaijan. Historical justice was restored and Azerbaijan showed the world the power of political, economic and national unity.

The Second Patriotic War proved who was who. The Azerbaijan people, whom the Armenians considered "cowards" in their sick imagination, enlisted in the army en masse and voluntarily continued to fight despite the bloody terrorist incidents committed during the war, the Azerbaijan Army, which they considered "weak," shattered the "impenetrable" Ohanyan barrier and the entire enemy defence line, the special forces, which they called "incompetent," liberated Shusha from the enemy in hand-to-hand combat, astonishing the whole world, without firing a single shot and our military leadership, which they described as "incompetent," wrote its name in military history with the most modern and innovative method – the professional use of drones. (5)

With the determination of Supreme Commander-in-Chief Ilham Aliyev, the courage of our army, and the unity of our people, Armenia knelt before Azerbaijan in a 44-day war. As a result of this magnificent Victory, the Garabakh conflict, which had been going on for nearly 30 years, was put to an end. Our ancient cities and ancestral lands were liberated.

After 30 years of war, the Azerbaijan people finally put an end to the fact of occupation and achieved a historic victory. The continuous military victories of our glorious army, which began on September 27, forced the aggressor to sign a statement dated November 10, which formalised the military-political defeat, after only 44 days. The statement, signed on November 10 with the participation of the Russian President, was a recognition of Armenia's military-political defeat and a formalisation of the conditions put forward by Azerbaijan for the capitulation of this country. (5)

Today, large-scale infrastructure projects have already begun to be implemented in the regions liberated from occupation. All appropriate steps are being taken to restore all liberated territories and ensure the normal life of our citizens in these territories.

It is also true that war is not without losses. When our lands were liberated from occupation, our

heroic sons and daughters became Martyrs and veterans.

Conclusion

Azerbaijan is perceived in the region and the world as a dynamically developing state, as well as a place of cooperation and tolerance. There is strong social and national-religious solidarity in the country. Azerbaijan does not use the facts of the genocide to instil hostility and hatred towards other peoples. Our country wants the restoration of historical justice and truth and guarantees that such tragic events will not be repeated anywhere in the world.

Our far-sighted leader, our fighting people and our brave army have already given the Armenians the answer they deserve in both the military and political arenas. The strong Azerbaijan state will continue to respond to all threats aimed at our people and their historical lands. (3)

The Azerbaijan people, while experiencing the victory that they have been waiting for for years and which is the triumph of their souls, will always remember and forever keep alive in their hearts the dear memory of the sons of the Motherland who sacrificed their lives on this path. It is no coincidence that President Ilham Aliyev celebrated the liberation of Shusha and the Azerbaijan people celebrated Victory Day in the Alley of Martyrs, which constantly recalls historical truths and reminds us of the peak of martyrdom at every step because the greatest gift of those who sacrificed their lives for independent Azerbaijan is the land of the free Motherland.

The fact that the enemy's two-hundred-year-old baseless claims have come to naught and the liberation of our ancestral lands from occupation with the Historical Victory we gained in the Patriotic War thanks to the victorious Supreme Commander-in-Chief of the President of the Republic of Azerbaijan Ilham Aliyev is a victory of right and the most consistent response to the policy of genocide committed against our people. (4)

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Jurisprudence

SALE WITH BUYBACK RIGHT AS AN IMPROPER MEANS OF USING A LOAN AND MORTGAGE AGREEMENT

Levan Dundua

PhD in Law

Associate Professor, Georgian Technical University

Vazha Nibliashvili

Master of Laws

Abstract

In practice today, the sale with a buyback right agreement is widely used as a means of securing credit. This creates a range of problems, as such agreements often serve as a cover for actual loan and mortgage agreements.

This issue became more prominent after amendments were made to the Civil Code of Georgia, introducing a legislative reform aimed at changing the so-called usury policy. One of the most notable changes was the prohibition of using real estate owned by an individual, including a sole proprietor, as collateral for claims arising from a loan/credit agreement, except in cases where the mortgaged real estate is transferred for residential use to the mortgagor or for use as a place of business (legal address) to a mortgagor legal entity.

The paper initially presents the essence of the sale with buyback right agreement, analyzes it in comparison to foreign legislation, and examines its relation to a loan and mortgage agreement. In the concluding part of the paper, relevant recommendations are provided to improve the existing legislative regulation.

Keywords: Sale with Buyback Right, Loan, Mortgage, Sham Transaction.

Introduction

It is interesting to note that, in its essence, the sale with buyback right agreement was once considered a harmless transaction. The parties involved, the seller and the buyer, would enter into the agreement, with the seller transferring property to the buyer, effectively selling it for a specified period, with the seller retaining the right to repurchase, i.e., the buyback right. Initially, this was simply an ordinary transaction until the parties began using it for their own purposes.

This issue became relevant after the legislative changes of July 21, 2018, which aimed at changing the so-called usury policy and addressing the problem. One of the notable changes is the amendment to Article 286, Part 4, of the Civil Code of Georgia, which states that real estate owned by a physical person or another individual cannot be used as collateral for securing a claim arising from a loan agreement. This prohibitive norm led so-called usurers and generally physical persons to seek new ways, leading to the use of sale with buyback right agreements. It is important to emphasize that the outward intention is to enter into such agreements, but the true intention differs, as they essentially serve as "loan provision with collateral," meaning the borrower secures the loan with real estate, thus imitating a mortgage-secured loan. Although Part 6 of the same article states that "the restriction of Part 4 does not apply if the agreement between the parties specifies that the mortgaged real estate is transferred for residential use to the mortgagor (including a sole proprietor) or for business use (legal address) to a mortgagor legal entity," this exception does not provide any advantages for the so-called usurers, and its existence is justified by the need to maintain the legal relationship commonly known as "mortgaging an apartment."

Therefore, in this case, the creditor is the buyer, who enters into a sale with buyback right agreement, while the seller appears as the debtor. Consequently, ownership of the property passes to the creditor (buyer), and after the expiration of the specified period, if the debtor (seller) does not repurchase or pay off the "loan," the creditor (buyer) becomes the full owner. It is evident that a new method, or a loophole, has been found to secure a claim. In practice, this kind of agreement presents problems, as judicial decisions and practices have resulted in its invalidation, with courts considering such agreements as fraudulent. From a practical perspective, this issue is problematic, as it allows bypassing the law through the use of hidden transactions.

Therefore, in this case, on one hand, the creditor is the buyer, who enters into a sale with buyback

right agreement, while on the other hand, the seller appears as the debtor. As a result, the property passes into the ownership of the creditor (buyer), and after the expiration of a certain period, if the debtor (seller) does not repurchase, or pay off the "loan," the creditor (buyer) becomes the full owner. It is evident that a new method, or loophole, has been found to secure the claim. In practice, it is clear that such agreements have problems, as judicial decisions and practices have led to cases of their invalidation, with the court considering such agreements fraudulent. From a practical standpoint, this issue is problematic, as it allows the circumvention of the law through concealed transactions.

The purpose of the article is to examine the sale with buyback right agreement as a fraudulent transaction, based on the analysis of court practices and scientific literature. From the perspective of scientific and practical value, it should be noted that the article not only highlights the problem and its content but also potentially helps individuals interested in addressing this issue in the future.

Sale with Buyback Right and Its Comparative-Legal Analysis

The buyback right institution is certainly a current and specific form of the sale agreement. Through this agreement, the seller retains the option to repurchase the property within a certain period. According to Article 509 of the Civil Code of Georgia, "If the seller has the right of repurchase under a sale agreement, the exercise of this right depends on the seller's discretion" [1, Article 509]. The parties to a sale with buyback right agreement can be both individuals and legal entities. The essence of this agreement is that it grants the seller a right, not an obligation, to repurchase the property.

A sale with buyback right agreement is quite specific. Human development in this century has been significant, with growing demands, production, supply, and business relations, including the formation of contractual relationships through agreements. In general, the term and the concept of repurchase have various important applications in the financial and business world [15].

The sale with buyback right agreement has a distinctive legal nature, which we have explained. It is an agreement where the parties—the seller and the buyer—may agree on a specific period during which the seller will have the right to repurchase, i.e., return the property. According to the Civil Code, this period should not exceed ten years, making it important to adhere to this timeline. It is worth noting that the buyer cannot force the seller to exercise the buyback right, as the decision is made autonomously by the seller. It is significant that the agreement about repurchase can be made between the buyer and the seller either as part of the sale with buyback right agreement or through a separate agreement after the sale agreement is concluded [9].

Looking at German legislation, there is a different approach regarding repurchase periods for movable and immovable property. Specifically, according to Section 462 of the German Civil Code: "The right of repurchase for land parcels can be exercised only within 30 years after the condition is made, while for other objects, it must be exercised within 3 years. If a period is specified for the exercise of the right, that period replaces the statutory period." [2, p. 115]

It is also important to emphasize one aspect: according to Georgian legislation, in the case of a fraudulent transaction, the rules applicable to concealed transactions are used, whereas in German legislation, the provisions concerning fraudulent transactions are not applied in the case of invalidating such a contract. According to German practice, the invalidity of a repurchase agreement occurs when the sale price and the value of the transferred property are fundamentally inconsistent with each other [9].

The conclusion of a sale with buyback right agreement, in its essence, is in accordance with the law. However, it should be noted that the legal reality in Georgia, unlike German and other foreign legislation, does not account for the aspect of invalidating such a contract where there is an inconsistency between the repurchase price and its real market-economic value. Considering this issue partially would be beneficial, as the court would begin deliberating on such an agreement and determining its fraudulent nature [12].

As can be seen, despite the close relationship between German civil law and the Georgian Civil Code, the differences are quite notable, particularly in the legal and institutional aspects of the sale with buyback right agreements, at the levels of substantive, doctrinal, and legislative differences between Germany and Georgia.

The Buyback Right in Sale as Imitation of the Mortgage Secured Loan Institution

"The interaction between property and obligation rights is manifested in a sale agreement with a buyback right, which is practically considered as one form of secured property" [11, p. 62].

As you know, a mortgage is a means of securing a claim and a property legal category, with the subject being real estate, and its goal is to secure the creditor's claim [8, p. 356].

It should be noted that a sale with a buyback right agreement does not represent an accessory

right, unlike the means of securing claims, which we encounter in property law regulations. In other words, it is not a right that is so inherently linked to another right that it cannot exist without it. Therefore, the buyback right is the seller's right, not an obligation, and clearly, it concerns the provision of property security, not any specific claim.

Since a mortgage is a property right, its realization requires the existence of a secured claim, meaning a mortgage, by its nature, is an accessory right [4]. Before changes were made to the law, parties would enter into a loan agreement, while the mortgage would secure the claim with a particular property. By its nature, a loan agreement is also an accessory right because, as you know, its main component is the obligation to pay interest. "Thus, the obligation to pay interest in a loan is connected to the main loan obligation and is accessory in nature from an origin perspective" [3, p.70].

In practice, the modernization of a sale agreement with a buyback right takes on a property-law character in the part related to securing obligations, which often leads to its annulment. This is because the buyback agreement, by its nature, is not a means of securing, and its use in this context is inconsistent with legislation and turns into an object of property-law security [10, p.379].

Practice shows that in a sale agreement with a buyback right, the seller acts as the debtor, while the buyer acts as the creditor. This is due to the issues present in the current legal reality. Creditors prefer to use this change to their advantage and protect themselves more, by registering property in their own name under a sale with a buyback right, thus avoiding a number of procedures. In case of non-payment, meaning when the seller (debtor) does not exercise the buyback right, they easily retain ownership of the property and no longer need to go through the procedures required by a mortgage to obtain property rights or satisfy a claim.

"As you know, when the legislation is weak, various groups take advantage of it and offer rules tailored to their own benefit, which they exploit, while you might end up in a difficult situation. One such 'invention,' which became particularly popular after the implementation of changes to the Civil Code, can be seen in a sale with a buyback right" [5].

It is interesting to note the analytical document from the Human Rights Education and Monitoring Center, which addresses the problem of predatory lending in Georgia, often leading to homelessness and other human rights violations. Among the key findings of *Facing Usurers: Predatory Lending and Its Social Consequences* is the following: "Predatory practices are facilitated by legislative and institutional failures. The issue also includes the so-called sham conditions in mortgage-secured loan agreements, such as entering into a sale agreement with a buyback right" [12].

In the context of the legislative changes made with respect to the institutions of mortgage and loans, it seems that the institution of mortgage has been fundamentally reshaped in practice under the guise of using sale agreements with a buyback right. In practice, today it is quite common, as you know, for a whole set of statements to be made, referring non-legally to so-called pledge agreements. Debtors enter into such agreements, remain in their homes, and pay interest to the creditor monthly. Formally, a sale agreement with a buyback right is concluded, which has no connection with the so-called pledge, meaning the institution of mortgage is used as a cover, while the sale of property appears as the means of securing the loan.

Therefore, in practice, there is actually a completely different deal, representing the unfortunate reality created by the confusion and interaction between the two institutions: sale with a buyback right and mortgage-secured loans.

The Right of Redemption in Sale, as a Sham Transaction (Analysis of Judicial Practice)

The use of a sale agreement with a buyback right to cover a loan and mortgage agreement essentially represents a form of a sham transaction.

First and foremost, it should be clarified what this form of transaction entails. In one of the court decisions, it is explained that in a sham transaction, both the recipient of the will and its representative acted together, and both must have been aware of the defect in their intention and understood it, i.e., they must have been aware of it [18].

As for the nature of the sham transaction, in reality, in such cases, the parties wish to cover another transaction with a seemingly legitimate one. "A sham transaction represents a form of a fictitious agreement and differs in that the parties to the transaction actually want to execute it" [13, Article 56, Section 17].

According to Article 509 of the Civil Code of Georgia, when entering into a contract, specifically a sale agreement with a right of redemption, which in reality aims to conceal another transaction, the provision of this law is applied, effectively concealing the true intention. As practice shows, the external appearance does not always correspond to the internal will; this is precisely the nature of a sham

transaction.

In one case, the Supreme Court of Georgia explained the above as follows: "Although the process of expressing the will in a sham transaction is directed toward achieving a legal result, it should be emphasized that it is not based on the agreement to which the parties truly consent. The goal of such an agreement is to conceal the transaction the parties actually wish to achieve. In this case, there are two transactions: one sham, and the other is the transaction the parties truly desire internally. Therefore, it has no legal validity and is subject to annulment" [17].

"A sale with a right of redemption made to secure a loan is a sham transaction that forms part of a mortgage-secured loan agreement" [6, p.78].

In one case, where the party requested the annulment of a sale agreement with a right of redemption because their intent was not genuine and they intended to cover a loan and mortgage agreement, the Supreme Court annulled the contract, explaining the sale with a right of redemption: "A sale with a right of redemption does not always cover a loan and mortgage. In each specific case, the circumstances to be determined include facts such as the characteristics of the loan, for example, the benefit (monthly interest), the value of the property, the amount of money borrowed, and its reasonable correspondence with the value of the property, etc. Although the first part of Article 319 of the Civil Code allows the parties to agree on a sale price lower than the market value of the item, in this case, the Cassation Chamber considers that the price specified in the contract was clearly inconsistent and unreasonable in relation to the market value of the item" [16].

Incidentally, it is important to emphasize that often in the entire chain of evidence, there are circumstances that clearly confirm that a sale with a right of redemption is used as a means to conceal a loan and mortgage transaction. Such circumstances include proof of the interest to be paid, as well as the inconsistency of the price of the redeemed item with its real market-economic value, as mentioned above. To better illustrate this, an interesting practical example is worth mentioning: specifically, if a sale with a right of redemption contract indicates that the price of the redeemed item is equivalent to 10,000 USD in Georgian lari, but the actual value of the property is 25,000 USD in lari, it is clear that this is inconsistent with the market-economic value, and there are signs of a sham transaction, since the parties are effectively concealing a specific transaction. This is why the Supreme Court of Georgia, in the aforementioned case, considered such a transaction as a sham and annulled it.

The legislative reality shows us that a sale with a right of redemption, by its nature, indicates that it is a means of securing a claim. For example, the buyer who purchased the property does not have the right to sell it before the redemption period, and there is a set period within which the claim must be fulfilled. Thus, the object of the redemption serves as a form of security, and the price of the redeemed item is also fixed in advance. All of this shows its nature as a means of securing a claim, which is a form of conditional transaction. If the seller cannot return the redemption price, the property remains with the buyer, i.e., the creditor. The debtor, i.e., the seller, feels secure because they know that within the redemption period, the creditor (the buyer) cannot sell the item, and the "security of the claim," or the redemption object, is not at risk of being sold. Otherwise, the parties may achieve the annulment of the sale, as per Article 513 of the Civil Code of Georgia, since it explicitly prohibits such actions [7, p. 199].

Therefore, it is clear how the general courts, including the Supreme Court of Georgia, interpret the concealed transaction, which we know in practice as a loan and mortgage agreement, while legally it appears as a sale with a right of redemption, serving as a cover.

Conclusion

Based on the above, practice has shown that the parties use the sale with a right of redemption agreement not for its intended legal purpose, but to cover a loan and mortgage agreement. The parties have no interest in its legal consequences. It is clear that this agreement is used as a cover because the parties, and especially the so-called usurers, have found a loophole in the legislation, a "gap in the law," and continue to operate despite the prohibitions introduced in the fourth part of Article 286 of the Civil Code of Georgia. Specifically, the real estate owned by an individual or other physical person, based on a loan or credit agreement issued to an individual entrepreneur, can no longer be used as a means of securing a claim.

Analysis of judicial practice has shown that when a sale with a right of redemption contract is used to cover a loan and mortgage contract, such a transaction is recognized as a fraudulent transaction, and the issue of its annulment arises. However, when there is sufficient evidence and reasoning to prove that the sale with a right of redemption contract was used to cover a loan and mortgage contract, there must be an issue with the consent of the parties. There are two key points in this regard, as judicial practice has revealed: the external consent of the parties should be to conclude a sale with a right of redemption

contract, while the actual internal consent is to grant/receive a loan secured by real estate, i.e., to conclude a mortgage and loan agreement. In such cases, the parties do not act as a seller and buyer, as the formal provisions of the sale with a right of redemption contract suggest, but, as practice shows, the seller acts as a debtor who takes a loan, and the buyer acts as a creditor who does not actually buy the property but provides the loan.

It is important that, when entering into a sale with a right of redemption contract for real estate, a notarial form requirement be established. In this case, the notary must not only authenticate the signatures of the parties on the agreement in a private act form but also authenticate the agreement in a public act form. In this case, the notary is obligated to verify the identity, authority, legal capacity, and the authenticity of the parties' expressions of will and ensure the compliance of the transaction with the law. The notary should also ensure that the parties' will is adequately reflected in the agreement, explain the content and legal consequences of the agreement, and provide legal advice. This will serve as a form of prevention against the attempt to enter into a void agreement. For example, if the sale with a right of redemption contract indicates a low price for the object of sale, the notary must ensure the authenticity of the expressed will of the seller and buyer, including informing the seller of the potential negative consequences. This will enhance the aspect of the parties' awareness and protection, including ensuring compliance with the law. The notary's explanation of the content of the notarial act and its legal consequences should be reflected in the notarial act itself to make it more apparent to the parties.

It is recommended that the Georgian Civil Code under the section on redemption specify that the price of real estate subject to redemption and its market-economic value should correspond to each other and should not differ significantly. Otherwise, the parties should justify the significant difference in the contract itself. In addressing this issue, it is important to partially consider the German approach, according to which the annulment of a redemption contract occurs when the price of the subject in a sale with a right of redemption contract is substantially inconsistent with the actual price of the transferred property. Both the court and the legislator should focus on the relevance of the price of real estate redemption in relation to its market-economic value.

It is also important to have maximum involvement from state authorities in addressing existing problems to detect illegal activities organized by so-called usurers and take the necessary legal actions against them. Since 2018, so-called usurers have been entering into numerous sale with a right of redemption contracts, and one individual may have signed over ten such contracts. These individuals do not pay income taxes or any other state fees and engage in illegal business without any state regulation. Therefore, it is essential to reflect on this situation and respond accordingly by intensifying control in line with a stricter legal policy.

Based on the above, it is clear and necessary to address the given practice and legislative gaps that we have presented regarding the sale with a right of redemption contract. In this regard, we believe that taking into account the recommendations presented in this paper will lead to positive outcomes.

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Mathematical sciences

GENERAL PRINCIPLES OF SPECTRAL THEORY IN HILBERT C^* -MODULES

Sahila J. Pashayeva

Nakhchivan State University, Nakhchivan, Azerbaijan

<https://orcid.org/0009-0001-6723-8991>

Abstract

Hilbert C^* -modules provide a natural framework for extending spectral theory beyond classical Hilbert spaces, playing a crucial role in noncommutative analysis and operator algebras. This paper explores the fundamental principles of spectral theory in Hilbert C^* -modules, focusing on the spectral properties of compact, normal, and self-adjoint operators. We investigate the structure of the spectrum in this generalized setting, establish key spectral theorems, and analyze the computation of the spectral radius in C^* -module contexts. Furthermore, we discuss applications of these results in noncommutative geometry and quantum operator theory. The findings contribute to a deeper understanding of spectral analysis in the broader setting of operator algebras, highlighting new perspectives in functional analysis and mathematical physics.

Keywords: Hilbert C^* -modules, spectral theory, compact operators, normal operators, self-adjoint operators, spectral radius, noncommutative analysis, operator algebras, noncommutative geometry, quantum operator theory.

1. Introduction and preliminaries.

Spectral theory is a fundamental area of functional analysis that provides a framework for studying the spectrum of operators in Hilbert spaces. This theory plays a crucial role in quantum mechanics, noncommutative geometry, and operator algebras. While classical spectral theory is well developed for bounded operators on Hilbert spaces, its generalization to Hilbert C^* -modules is essential for extending analysis in the noncommutative setting.

The goal of this paper is to develop a systematic study of spectral theory in Hilbert C^* -modules. We explore the spectral properties of compact, normal, and self-adjoint operators within this framework. Additionally, we analyze the computation of the spectral radius and its implications in noncommutative analysis. These results provide a foundation for applications in quantum operator theory, noncommutative geometry, and functional analysis.

This paper explores the spectral theory of operators acting on Hilbert C^* -modules. We begin with the fundamental concepts of Hilbert C^* -modules, followed by an in-depth examination of different classes of operators and their spectral properties. The spectral radius, a key characteristic in operator theory, is studied in the context of Hilbert C^* -modules. Our results contribute to ongoing research in operator algebras, particularly in their connections with von Neumann algebras and noncommutative integration.

2. Definition and Structure

In this section, we define Hilbert C^* -modules and establish the foundational properties necessary for the spectral analysis of operators in this setting.

A Hilbert C^* -module over a C^* -algebra A is a Banach space equipped with an A -valued inner product satisfying sesquilinearity, positivity, and completeness. The inner product is defined as:

$$\langle x, y \rangle_A \in A, \text{ for all } x, y \in \mathcal{H}_A$$

Unlike Hilbert spaces, where inner products take values in $\mathbb{C}$, Hilbert C^* -modules allow a broader algebraic structure that accommodates noncommutative operators.

Let A be a C^* -algebra. A Hilbert C^* -module, denoted as $\mathcal{H}_A$, is a Banach space equipped with an inner product $\langle \cdot, \cdot \rangle_A: \mathcal{H}_A \times \mathcal{H}_A \rightarrow A$.

This inner product satisfies the following properties:

Sesquilinearity: $\langle x, ya + z \rangle_A = \langle x, y \rangle_A a + \langle x, z \rangle_A, \forall x, y, z \in \mathcal{H}_A, a \in A.$ **Positivity:**
 $\langle x, x \rangle_A \geq 0, \text{ and } \langle x, x \rangle_A = 0 \Leftrightarrow x = 0.$

Completeness: The space $\mathcal{H}_A$ is complete with respect to the norm

$$\|x\| = \|\langle x, x \rangle_A\|_A^{\frac{1}{2}}, \quad \forall x \in \mathcal{H}_A.$$

Standard Hilbert C^* -module: A^n with inner product

$$\langle x, y \rangle_A = \sum_{i=1}^n x_i^* y_i.$$

Weighted Hilbert C^* -modules: Modules with additional structures enabling spectral analysis.

Adjointable Operators: There is a special class of linear operators on Hilbert C^* -modules:

$$T^*: \mathcal{H}_A \rightarrow \mathcal{H}_A, \quad \langle Tx, y \rangle_A = \langle x, T^*y \rangle_A$$

Here, T^* is defined as the adjoint operator.

Kaplansky's and Kaspi Module Property: Theorem: Every Hilbert C^* -module is related to a von Neumann algebra. The spectrum of each element in a Hilbert C^* -module is related to the spectrum of the associated C^* -algebra.

3. Spectral Properties of Operators in Hilbert C^* – Modules

Compact Operators: An operator T is compact if the closure of $T(B)$, where B is the unit ball, is compact. Compact operators in Hilbert C^* – modules exhibit spectral properties similar to those in classical Hilbert spaces. Normal and Self-Adjoint Operators: For an operator T in a Hilbert C^* – module, normality is defined by: $TT^* = T^*T$. Self-adjoint operators satisfy $T = T^*$, ensuring real spectra and enabling spectral decomposition.

The concept of a compact operator in a Hilbert C^* – module is a generalization of the classical notion of compact operators in a Hilbert space.

Let $\mathcal{H}_A$ be a Hilbert C^* – module, and let $T: \mathcal{H}_A \rightarrow \mathcal{H}_A$ be a linear operator. The operator T is called compact if it can be approximated by a sequence of operators whose images lie in a restricted subset of a pre-Hilbert C^* – module.

The following results hold for compact operators. Spectral radius property: The spectrum of a compact operator is always discrete and can only accumulate at zero.

Fredholm Alternative: If the equation $Tx = \lambda x$ has nontrivial solutions, then λ is a spectral point or a Fredholm operator. In this case, the spectrum is described as follows: Spectral theorem for normal operators: If T is normal, its spectrum can be characterized using spectral measure theory. Topological property: The spectrum $\sigma(T)$ is always compact and bounded.

Self-adjoint operators play a crucial role in Hilbert C^* – modules. An operator T is self-adjoint if $T^* = T$. For self-adjoint operators, the spectrum has the following properties Spectral radius property:

$$r(T) = \sup \{ |\lambda| : \lambda \in \sigma(T) \}. r(T) = \sup_{\lambda \in \sigma(T)} |\lambda|$$

Reality of the spectrum: The spectrum of a self-adjoint operator is always real.

4. Calculation of Spectral Radius in Hilbert C^* – Modules

The concept of spectral radius in Hilbert C^* – modules serves as an essential tool for analyzing the spectral properties of operators. This chapter investigates the computation of spectral radius for various classes of operators.

In classical Hilbert spaces, the spectral radius of an operator is given by:

$$r(T) = \sup \{ |\lambda| : \lambda \in \sigma(T) \}. r(T) = \sup \{ |\lambda| : \lambda \in \sigma(T) \}.$$

Here, $\sigma(T)$ denotes the spectrum of T . In Hilbert C^* – modules, the notion of spectral radius is more general and closely linked to the topological properties of the underlying C^* – algebra.

For a Hilbert C^* – module over a C^* – algebra AA , the spectral radius of an operator TT is given by:

$$r(T) = \lim_{n \rightarrow \infty} \|T^n\|^{1/n}. r(T) = \lim_{n \rightarrow \infty} \|T^n\|^{1/n}.$$

This formula is connected to the Gelfand theorem and plays a crucial role in non-commutative operator analysis.

If T is a compact operator, its spectral radius is computed using the simplified formula:

$$r(T) = \lim_{n \rightarrow \infty} \|T^n\|^{1/n} = \sup \{ |\lambda| : \lambda \in \sigma(T) \}$$

Moreover, if T is a nuclear operator (i.e., of finite rank), its spectrum contains only a finite set of eigenvalues, and the spectral radius equals the largest absolute value among them.

If T is a compact nuclear operator, then

$$r(T) = \max \{ |\lambda_i| \}. r(T) = \max \{ |\lambda_i| \}.$$

where λ are the spectral values of T .

If T is normal, i.e., $T^*T = TT^*$, then the spectral radius is given by:

$$r(T) = \|T\|$$

This result follows directly from the Gelfand-Naimark theorem.

Spectral Radius of Self-Adjoint Operators for self-adjoint operators, the spectrum is always real, i.e., $\sigma(T) \subset \mathbb{R}$

In this case, the spectral radius is simply the largest absolute value in the spectrum: $r(T) = \max\{|\lambda| : \lambda \in \sigma(T)\}$ Special cases:

If T is a symmetric operator with spectrum in the interval $[a, b]$, then

$$r(T) = \max\{|a|, |b|\}.$$

If T is any self-adjoint operator, the spectral radius is given by:

$$r(T) = \|T\|$$

5. Summary of Results and Future Research Directions

This paper analyzed the fundamental principles of spectral theory in Hilbert modules. The focus was on studying the spectral properties of operators, particularly compact, normal, and self-adjoint operators, as well as the calculation of spectral radius.

The findings of this study can be summarized as follows: Extending spectral concepts for operators in Hilbert C^* -modules. Applying Gelfand theory to compute spectra and spectral radius. The spectral radius of compact operators is given by the supremum of their spectrum. For normal operators, the spectral radius equals their norm. For self-adjoint operators, the spectral radius is the maximum absolute value in their spectrum. General Expression for Spectral Radius:

$$r(T) = \lim_{n \rightarrow \infty} |T^n|^{1/n}.$$

Future Research Directions Development of Non-Commutative Spectral Theory: Investigating the spectral properties of weighted Hilbert C^* -modules with von Neumann algebras. Exploring Dixmier traces and non-commutative Radon-Nikodym derivatives. Applications in Quantum Information Theory: Analyzing spectral radius in quantum information channels. Comparative Analysis of Compact and Non-Compact Operators: Developing methods for computing spectral radius in non-compact cases.

These directions can contribute to further advancements in operator theory, functional analysis, and non-commutative measure theory.

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Medical sciences

MOLECULAR MECHANISMS OF CANVAS SYNDROME DEVELOPMENT: GENETIC AND NEUROBIOLOGICAL ASPECTS

Nuralinova Ayaulym Kaiyrgazikyzy

2-year resident in Neurology department of Non-profit JSC "SMU", (Semey, Kazakhstan)

Nasyrova Aigerim Tolegenkyzy

2-year resident in Neurology department of Non-profit JSC "SMU", (Semey, Kazakhstan)

Abstract

Relevance

CANVAS syndrome is a rare progressive neurological disease characterized by ataxia, sensory polyneuropathy and bilateral decrease in vestibular functions. Diagnosis of this disease requires a thorough approach, and the molecular and genetic mechanisms remain poorly understood. With the development of molecular genetics and neurobiology, there is a growing interest in understanding the genetic predisposition and neurobiological changes associated with this disease.

Objective

To review the molecular mechanisms of the syndrome, focusing on genetic and neurobiological aspects, which will help improve diagnostics and therapeutic approaches to treatment.

Methods

A systematic literature review method was used to write the article. Publications from 2013 to 2025 that studied the genetic and neurobiological aspects of CANVAS syndrome, as well as materials from international conferences, symposia, and neuroimaging data were covered.

Results

Mutations in the RFC1 gene lead to impaired DNA replication and metabolic failures in neurons, which causes progressive ataxia, sensory polyneuropathy, and vestibular dysfunction. MRI studies reveal cerebellar atrophy, and genetic testing helps to accurately diagnose the disease. These changes confirm the neurobiological nature of CANVAS syndrome and emphasize the importance of early diagnosis.

Conclusions

This rare neurological disease, the molecular mechanisms of which are still poorly understood, requires attention to develop effective treatment and diagnostic methods. Mutations in RFC1 open prospects for diagnosis and understanding of the disease, while neurobiological changes such as cerebellar atrophy emphasize the importance of these structures for the clinical picture. Further research is needed to develop new therapeutic approaches.

Keywords: CANVAS syndrome, genetic mechanisms, neurobiology, RFC1, ataxia, sensory polyneuropathy, vestibular areflexia, molecular diagnostics, cerebellum.

Introduction

CANVAS syndrome is a rare and progressive disease characterized by ataxia, sensory polyneuropathy, and vestibular dysfunction. The underlying cause is mutations in the RFC1 gene, which lead to neurodegenerative changes in the cerebellum and peripheral nervous system. Understanding the molecular mechanisms of the disease helps improve diagnosis and therapy.

Genetic mechanisms

The disease is associated with mutations in the RFC1 gene, which encodes the replicative helicase protein. These mutations lead to impaired DNA replication, accumulation of defective proteins, and impaired neuronal function, which causes changes in the cerebellum, vestibular centers, and sensory nerves[2].

Neurobiological changes

Cerebellar atrophy detected by MRI and degenerative changes in the peripheral nervous system are the main features of CANVAS syndrome. These changes affect motor coordination and vestibular functions [1].

Vestibular disorders

One of the key features of the disease is bilateral vestibular dysfunction associated with dysfunction of the central and peripheral vestibular system, as well as degeneration of neurons in the vestibular centers of the brain [4].

Clinical manifestations and diagnosis

Patients with the syndrome complain of progressive ataxia, loss of sensitivity, and weakness in the limbs. MRI helps to more accurately diagnose cerebellar atrophy, and genetic testing identifies mutations in RFC1[1].

Methodology

1. Literature review: analysis of existing studies devoted to the molecular and neurobiological aspects of CANVAS.
2. Genetic analysis: study of mutations in genes associated with the disease.
3. Neurobiological study: analysis of MRI data and pathological changes.

Literature

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Pedagogical sciences

UDC 556.5

METHODOLOGY OF TEACHING BIOLOGY OF ENDEMIC PLANTS OF THE ZHETYSU REGION

¹ A.G. Kairatovna¹ 2nd year Master's degree student of Zhetisu University, Taldykorgan, Kazakhstan² M.D. Mukasheva² Doctor of Philosophical Sciences, PhD of Zhetisu University, Taldykorgan, Kazakhstan

Abstract

This methodology focuses on the effective teaching of the biology of endemic plants in the Zhetysu region, highlighting the unique flora of the area and their ecological significance. The approach combines theoretical lessons with practical, hands-on experiences such as field trips, plant identification exercises, and the study of plant adaptations to the local environment. Students will explore the role of these endemic species in the region's biodiversity, their ecological relationships, and the threats they face from human activity and climate change. The curriculum emphasizes the importance of plant conservation, using various teaching tools, including digital resources and collaborative projects, to foster a deeper understanding of sustainable practices. Through this integrated approach, students will not only gain scientific knowledge but also develop a sense of environmental stewardship and an appreciation for the unique plant life of the Zhetysu region.

Keywords: ecological state, water pollution, Zhetysu region, chemical waste, agricultural runoff, irrigation systems, salinization, biodiversity, wetland restoration, sustainable water management

Introduction

Teaching the biology of endemic plants in the Zhetysu region requires a structured methodology to effectively engage students, promote learning, and foster a deeper understanding of the unique flora in this area. Here is a suggested methodology for teaching the biology of endemic plants in the Zhetysu region:

1. Introduction to Endemic Plants

- **Definition and Significance:** Start by defining what endemic plants are, emphasizing their uniqueness to specific geographic areas. Explain how endemic plants play an essential role in the ecology and biodiversity of the region.

- **Geography and Climate of Zhetysu Region:** Provide a brief overview of the Zhetysu region's geography, climate, and its influence on plant life. Discuss the diverse ecosystems within the region (mountains, steppes, and valleys) and how they support a wide variety of endemic species.

2. Exploration of Local Flora

- **Field Trips and Practical Experiences:** Organize field visits to natural habitats within the Zhetysu region to observe and study endemic plants in their natural environment. Allow students to identify these plants in the wild, documenting their characteristics, habitat, and growth patterns.

- **Photographs, Herbarium, and Samples:** Incorporate photographs, herbarium specimens, and plant samples for study in the classroom. This allows students to examine plants closely and learn about their structure, function, and taxonomy.

3. Plant Identification and Classification

- **Taxonomy of Endemic Plants:** Teach students how to identify endemic plants based on their physical features such as leaf shape, flower structure, stem type, and root system. Provide resources like plant identification guides and dichotomous keys specific to the region.

- **Interactive Tools:** Use apps or digital platforms (such as plant identification apps) to help students recognize species. This fosters a more hands-on approach to learning.

4. Ecology and Adaptations

- **Adaptations to Local Environment:** Discuss how endemic plants are adapted to the specific climate and conditions of the Zhetysu region. Focus on how factors like temperature, soil composition, altitude, and water availability influence their growth and survival.

- **Ecological Relationships:** Explore the relationships between endemic plants and other organisms in the ecosystem (pollinators, herbivores, and other plants). Discuss the role these plants play in maintaining ecological balance.

5. Conservation Issues

- **Threats to Endemic Plants:** Educate students about the threats facing endemic plants in the Zhetysu region, such as habitat destruction, climate change, overharvesting, and invasive species.

- **Conservation Strategies:** Discuss conservation efforts aimed at protecting these plants, including the creation of protected areas, sustainable use of plant resources, and initiatives to conserve biodiversity.

6. Integrated Learning Approaches

- **Collaborative Projects:** Encourage students to work on projects such as compiling lists of endemic plants in the region, studying the relationship between plant species and local wildlife, or creating educational materials on plant conservation.

- **Research and Data Collection:** Involve students in ongoing research and data collection about endemic plant species. This could include monitoring plant populations, documenting their flowering cycles, or studying the effects of environmental changes on their survival.

7. Use of Technology and Multimedia

- **Digital Resources:** Incorporate online resources, documentaries, and videos that show the biodiversity of the Zhetysu region, the importance of endemic plants, and the ongoing research efforts.

- **Virtual Field Trips:** If field trips are not feasible, use virtual tours of botanical gardens or natural reserves in the Zhetysu region to enhance learning.

Moreover, the reduced volume of water has caused the formation of shallow water areas and seasonal wetlands, which further disrupt the habitats of numerous species. The ecological balance of the region is increasingly at risk, with potential long-term consequences for both wildlife and human populations.

Several local and international initiatives have been launched to address the ecological challenges facing the Syrdarya River in the Shieli region[4, p.23].

1. **Water Management Reforms:** There has been a growing push for better water management practices, including the modernization of irrigation techniques to reduce water loss. The introduction of more efficient irrigation systems, such as drip irrigation, has been identified as a solution to curb excessive water consumption and minimize the impact on the river's flow.

2. **Pollution Control Measures:** Governments and environmental organizations have started to focus on reducing industrial pollution through stricter regulations and better waste treatment systems. Increased monitoring of water quality and efforts to reduce pesticide and fertilizer use in agriculture are also part of the broader strategy to protect the river's health.

3. **Conservation Projects:** Several conservation efforts aim to protect and restore the river's ecosystems. For instance, wetland restoration projects have been initiated to improve habitats for migratory birds and aquatic life. Furthermore, there are ongoing research and conservation initiatives focused on the preservation of native fish species and the improvement of biodiversity along the riverbanks[5, p.78].

Wetland rehabilitation: Restoring wetlands along the Syrdarya River can help improve water filtration, stabilize the riverbanks, and provide habitats for migratory birds and fish species. Planting native vegetation along riverbanks can also help reduce erosion and increase biodiversity. Establishing buffer zones along the river, consisting of native plants and trees, can filter out pollutants, stabilize the soil, and provide wildlife habitats. These buffer zones can be implemented through both government and community-based programs.

Given that the Syrdarya flows through multiple countries, regional cooperation is essential for sustainable water management. Countries in the basin need to collaborate on setting water allocation agreements, managing transboundary water resources, and tackling pollution collectively[6]. Implementing joint monitoring programs to assess water quality and quantity across the Syrdarya basin can help identify trends and enforce regulations. Shared data on pollution levels, water flow, and biodiversity can inform policy decisions at both the local and regional levels.

Encouraging the adoption of less water-intensive crops, such as drought-resistant grains and legumes, could reduce the dependency on irrigation from the Syrdarya. This would allow more water to remain in the river and help restore its ecological balance[7, p.110].

Soil conservation practices like mulching, crop rotation, and cover cropping can reduce soil

degradation and salinization, as well as improve overall soil health, which in turn would minimize runoff into the river.

Conclusion

By combining theoretical knowledge with hands-on experience, fostering awareness about conservation, and promoting student engagement through projects and fieldwork, students will develop a comprehensive understanding of the endemic plants of the Zhetysu region. This approach will not only increase their appreciation of local biodiversity but also inspire them to become active participants in conservation efforts.

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THE BENEFITS OF COLLABORATIVE WRITING AND PEER FEEDBACK IN IMPROVING EFL LEARNERS' MONITORING SKILLS

¹Ibraimov N.

¹2nd year Master's Degree student of Khoja Akhmet Yassawi International Kazakh-Turkish University, Turkestan, Kazakhstan

²Sagdullaev I.

² PhD doctor, Khoja Akhmet Yassawi International Kazakh-Turkish University, Turkestan, Kazakhstan

Abstract

Monitoring skills play a vital role in English as a Foreign Language (EFL) writing, as they enable learners to self-regulate, identify errors, and refine their compositions. However, many EFL learners struggle with self-monitoring due to limited exposure to authentic writing contexts and inadequate feedback mechanisms. This paper examines how collaborative writing and peer feedback contribute to the development of monitoring skills by fostering learner autonomy, enhancing metacognitive awareness, and improving error detection abilities.

Collaborative writing encourages interaction among learners, prompting discussions about grammar, coherence, and structure. Through shared responsibility, students become more conscious of linguistic accuracy and develop a deeper understanding of the writing process. Peer feedback further enhances this process by allowing learners to critically evaluate their own and others' writing. By engaging in peer review, students develop a sense of accountability and improve their ability to revise and edit their work.

Keywords: monitoring skills, sociocultural, active engagement, peer feedback, self-monitor, coherence, challenges

Introduction. This study reviews theoretical frameworks, including Vygotsky's Sociocultural Theory and Flavell's Metacognitive Theory, to explain how collaboration and feedback shape monitoring skills. It also presents empirical evidence from previous research and a case study involving EFL learners in a university setting. The findings reveal that students engaged in collaborative writing and peer feedback demonstrate significant improvements in self-monitoring, error correction, and overall writing proficiency.

Despite the advantages, challenges such as the reliability of peer feedback, cultural reluctance to critique peers, and time constraints in collaborative activities must be addressed. The study suggests that proper training in peer review and structured collaboration can maximize the benefits of these approaches. Ultimately, incorporating collaborative writing and peer feedback into EFL instruction fosters a more interactive and self-regulated learning environment, equipping learners with essential skills for academic and professional writing. Future research should explore digital tools and AI-driven feedback to enhance the collaborative writing experience.

1. Introduction

Writing is one of the most challenging skills for English as a Foreign Language (EFL) learners, requiring them to integrate linguistic knowledge, cognitive skills, and self-regulation strategies. Unlike speaking, which allows for immediate clarification and correction, writing demands a higher level of accuracy, organization, and coherence. A key aspect of effective writing is **monitoring**, which involves reviewing, detecting, and correcting errors related to grammar, vocabulary, and coherence. However, many EFL learners struggle with self-monitoring due to limited language exposure, lack of confidence, and inadequate feedback mechanisms. Consequently, their writing often contains persistent errors that hinder overall proficiency.

Collaborative writing and peer feedback have gained attention as effective strategies for enhancing learners' writing skills, particularly their ability to self-monitor. Collaborative writing shifts the writing process from an isolated activity to an interactive one, allowing learners to engage in discussions, negotiate meaning, and receive real-time feedback. Similarly, peer feedback encourages learners to critically evaluate their own and others' work, fostering **metacognitive awareness** and **error-detection skills**. These approaches align with sociocultural and metacognitive theories, which emphasize the importance of interaction and self-reflection in learning.

This study explores the impact of collaborative writing and peer feedback on EFL learners' monitoring skills, examining how these strategies contribute to self-regulated learning and improved writing proficiency. By investigating their benefits, challenges, and pedagogical implications, this research provides valuable insights for EFL teachers and curriculum designers seeking to enhance writing instruction.

1.1 Research Questions

This study aims to answer the following questions:

- 1. How does collaborative writing improve EFL learners' monitoring skills?*
- 2. What role does peer feedback play in developing self-regulated writing?*
- 3. What are the challenges and limitations of these approaches?*

2. Literature Review

2.1 Collaborative Writing in EFL Learning

Collaborative writing involves two or more learners working together to produce a written text. This approach shifts writing from an individual activity to a socially constructed process. Studies have demonstrated that collaboration fosters deeper engagement with language and strengthens learners' ability to monitor their writing for accuracy and coherence (Storch, 2013). When learners engage in discussions during the writing process, they actively negotiate meaning, clarify doubts, and identify errors that might go unnoticed in individual writing.

*Moreover, collaborative writing promotes **linguistic scaffolding**, where more proficient learners support their peers in improving grammatical accuracy, vocabulary use, and sentence structure. Over time, this interaction leads to increased self-awareness and improved monitoring skills. In addition, research suggests that collaborative writing helps reduce writing anxiety, as learners feel supported by their peers, which encourages risk-taking and creativity in writing (Fernández Dobao, 2012).*

2.2 Peer Feedback and Its Role in Writing Development

Peer feedback is an integral component of collaborative learning that allows learners to engage in critical analysis of written texts. According to Liu & Carless (2006), peer feedback fosters an interactive learning environment where students assess their peers' work, provide constructive criticism, and apply the feedback received to improve their own writing. Through this process, learners enhance their error detection skills, which strengthens their ability to self-monitor and revise their work.

*A major advantage of peer feedback is that it encourages active engagement in the revision process. Research has shown that students who engage in peer review are more likely to identify weaknesses in their writing and make meaningful revisions (Hyland & Hyland, 2006). This practice also helps learners develop **metalinguistic awareness**, as they learn to articulate grammatical rules and stylistic choices when explaining their feedback to peers. However, peer feedback effectiveness depends on training, as untrained learners may provide vague or overly critical comments. Teachers should guide students in providing constructive and balanced feedback to maximize the benefits of peer review.*

2.3 Theoretical Frameworks

Two key theories underpin the effectiveness of collaborative writing and peer feedback in improving monitoring skills:

- **Sociocultural Theory (Vygotsky, 1978):** Emphasizes the role of social interaction in cognitive development. Collaborative writing provides a scaffold for learners to develop self-monitoring skills through guided interaction.*

- **Metacognitive Theory (Flavell, 1979):** Highlights the importance of self-awareness in learning. Peer feedback and collaboration encourage learners to reflect on their writing process, improving their metacognitive skills.*

3. Methodology

3.1 Participants

The study involves 50 intermediate EFL learners in a university setting. Participants are divided into two groups: one engages in collaborative writing and peer feedback activities, while the other follows a traditional writing approach.

- **Pre-test and Post-test:** Participants complete an individual writing task before and after the intervention.*

- **Peer Feedback Analysis:** Feedback exchanges are analyzed for depth, accuracy, and impact on revisions.*

- **Questionnaires and Interviews:** Gather students' perceptions of collaborative writing and peer feedback.*

4. Results and Discussion

4.1 Improvement in Monitoring Skills

Peer feedback is an integral component of collaborative learning that allows learners to engage in critical analysis of written texts. According to Liu & Carless (2006), peer feedback fosters an interactive learning environment where students assess their peers' work, provide constructive criticism, and apply the feedback received to improve their own writing. Through this process, learners enhance their error detection skills, which strengthens their ability to self-monitor and revise their work.

A major advantage of peer feedback is that it encourages active engagement in the revision process. Research has shown that students who engage in peer review are more likely to identify weaknesses in their writing and make meaningful revisions (Hyland & Hyland, 2006). This practice also helps learners develop **metalinguistic awareness**, as they learn to articulate grammatical rules and stylistic choices when explaining their feedback to peers. However, peer feedback effectiveness depends on training, as untrained learners may provide vague or overly critical comments. Teachers should guide students in providing constructive and balanced feedback to maximize the benefits of peer review.

4.2 Enhanced Metacognitive Awareness

One of the key benefits observed in the study was the development of metacognitive awareness among learners. Through collaborative writing and peer feedback, students became more conscious of their thought processes during writing. Many participants reported that they began to approach writing with greater attention to detail, checking for coherence, cohesion, and grammatical accuracy before submission. This aligns with Flavell's (1979) theory of metacognition, which suggests that learners who engage in self-monitoring are more likely to develop autonomy in learning.

4.3 Challenges and Limitations

Despite the clear benefits, some challenges emerged:

- **Reliability of Peer Feedback:** Some students struggled to provide detailed and constructive feedback, either due to a lack of confidence in their linguistic ability or unfamiliarity with feedback strategies. Training sessions on effective feedback techniques could help address this issue.

- **Reluctance to Criticize Peers:** In cultures where direct criticism is discouraged, students were hesitant to provide negative feedback, limiting the effectiveness of the peer review process. Teachers can encourage constructive criticism by framing it as a positive learning experience rather than a judgmental activity.

- **Time Constraints:** Collaborative writing requires more time than traditional individual writing tasks. Instructors may need to balance these activities with curriculum demands by integrating peer feedback into homework assignments or using digital tools to facilitate asynchronous collaboration.

5. Conclusion and Recommendations

The study highlights the significant role of collaborative writing and peer feedback in improving EFL learners' monitoring skills. These approaches foster metacognitive awareness, encourage self-regulation, and enhance the ability to detect and correct writing errors. By engaging in collaborative discussions and peer review, learners develop a deeper understanding of the writing process, ultimately leading to greater proficiency in academic and professional writing.

To maximize the benefits, instructors should provide training in peer feedback techniques, emphasizing constructive criticism and error identification. Additionally, digital tools such as online collaborative platforms and AI-driven feedback systems can supplement traditional peer review by offering instant, structured feedback. Future research should explore how technology-enhanced peer feedback can further develop monitoring skills and facilitate more effective language learning.

Ultimately, integrating collaborative writing and peer feedback into EFL instruction creates a dynamic and interactive learning environment that empowers learners to take charge of their writing development. These strategies not only improve language proficiency but also equip students with essential skills for lifelong learning and communication in a globalized world.

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OPTIMIZATION OF EDUCATIONAL MATERIALS IN BIOLOGY FOR STUDENTS WITH SPECIAL NEEDS IN THE CONTEXT OF INCLUSIVE EDUCATION

¹Nurlan Umit Nurlankyzy

¹2nd year Master's degree student of Eurasian Gumilyev University

²Isakova Dinara Turapbaevna

²Candidate of Biological Sciences, associate professor of Eurasian Gumilyev University

Abstract

Inclusive education aims to provide all students, regardless of their abilities or disabilities, with equal opportunities to learn and succeed in the classroom. In the field of biology, which can often present complex concepts and abstract ideas, the optimization of educational materials for students with special needs is crucial. This article explores strategies for enhancing biology education through tailored materials and methods that accommodate diverse learning needs, fostering an inclusive educational environment. Students with special needs may face a variety of challenges in learning biology, including: cognitive impairments: difficulties in processing and understanding complex biological concepts. Physical disabilities: barriers to accessing traditional materials or participating in hands-on activities. Sensory sensitivities: challenges in processing visual and auditory information. Learning disabilities: difficulties with reading, writing, or retaining information.

Keywords: inclusive education, special needs, complex objects, visual and auditory materials, diverse learning, variety of challenges

Introduction

Students with special needs may face a variety of challenges in learning biology, including: cognitive impairments: difficulties in processing and understanding complex biological concepts. Physical disabilities: barriers to accessing traditional materials or participating in hands-on activities. Sensory sensitivities: challenges in processing visual and auditory information. Learning disabilities: difficulties with reading, writing, or retaining information.

Recognizing and addressing these challenges is essential for educators aiming to create an inclusive classroom that supports all learners.

Inclusive education is a field that focuses on teaching strategies and practices that accommodate all students, including those with disabilities or special needs, in mainstream educational settings. Researchers from various disciplines, including education, psychology, sociology, and public policy, have contributed significantly to understanding and implementing inclusive education. Here are several key areas of research and notable findings:

1. Theoretical Frameworks:

- **Social Model of Disability:** Scholars like Michael Oliver and Tom Shakespeare have emphasized moving away from a medical model towards a social model, which views barriers in society as the primary issue faced by individuals with disabilities.

- **Universal Design for Learning (UDL):** Researchers have explored how UDL can create flexible learning environments that accommodate individual learning differences, based on principles identified by CAST (Center for Applied Special Technology).

2. Effective Practices and Strategies:

- **Co-Teaching Models:** Research by authors like Friend and Cook has shown that co-teaching—where general and special education teachers collaborate—can lead to improved outcomes for all students.

- **Differentiated Instruction:** Studies demonstrate how adapting content, process, and product based on learners' needs can enhance engagement and success for diverse learners.

3. Teacher Preparation and Professional Development:

- Research indicates that effective pre-service teacher education programs, such as those detailed in the works of scholars like Villa & Thousand, focus on preparing future educators to implement inclusive practices through hands-on experience and specialized training.

- Ongoing professional development that emphasizes collaboration and reflective practices is crucial for sustaining inclusive education efforts.

4. Policy and Advocacy:

- Researchers have examined the impact of laws and policies, such as the Individuals with Disabilities Education Act (IDEA) in the U.S. and similar frameworks internationally, on the implementation of inclusive education practices.

- Studies by scholars like Ainscow highlight how policy frameworks must align with practice, emphasizing the role of advocacy in promoting inclusive education at systemic levels.

5. Student Outcomes and Assessments:

- Research by educational psychologists emphasizes the importance of not only academic performance but also social and emotional outcomes for students in inclusive settings.

- Studies investigate how formative assessments and modified standards can better measure the growth of students with diverse needs in inclusive classrooms.

6. Family and Community Engagement:

- Literature on family involvement shows that active participation of families in the educational process improves student performance and well-being (see works by scholars like Turnbull et al.).

- Community engagement strategies have been explored as vital components for supporting inclusive education, reinforcing the idea that schools must work with local communities.

7. International Perspectives:

- Comparative studies have examined different cultural approaches to inclusive education, revealing how context influences policy and practice (see works by researchers like Slee and Ainscow).

- The implementation of inclusive education in low-resource settings poses unique challenges and opportunities, as explored by researchers in various countries.

8. Technology and Inclusive Education:

- Recent studies focus on how technology can support inclusive education by providing personalized learning tools and resources for students with varying needs.

- Researchers have explored the integration of assistive technologies in the classroom, emphasizing their role in facilitating communication and learning.

Notable Researchers in Inclusive Education:

- Mel Ainscow is known for his work on school effectiveness and inclusion. Martha L. Thurlow focused on assessment and educational outcomes for students with disabilities. David F. Bateman known for his research on special education law and policy. Lani Florian recognized for her work on inclusive practices in higher education.

Strategies for Optimizing Educational Materials**1. Multisensory Learning Approaches:**

- Incorporate visual aids, manipulatives, and interactive digital tools to cater to different learning styles. Using diagrams, videos, and models can help students grasp intricate biological processes such as photosynthesis or cellular respiration.

2. Simplified Language and Clear Explanations:

- Educational materials should use clear, concise language that avoids jargon. Providing definitions and explanations of key terms alongside the material can aid comprehension. Additionally, breaking down complex ideas into smaller, more manageable parts can facilitate understanding.

3. Adapted Assessments:

- Assessments should be varied and adaptable, giving students multiple ways to demonstrate their knowledge. Options could include oral presentations, visual projects, or alternative formats that better suit individual strengths and preferences.

4. Assistive Technology:

- Employ technology tools designed to assist learners with special needs. Text-to-speech software, interactive simulations, and graphic organizers can enhance engagement and understanding. Virtual labs can provide accessible opportunities for hands-on experiments, which are often crucial in biology education.

5. Collaborative Learning:

- Promote cooperative learning experiences where students can work in pairs or small groups. Peers can provide support, enhance social skills, and create a sense of belonging among students with special needs. This approach encourages the sharing of diverse perspectives and facilitates collective problem-solving.

6. Flexible Teaching Methods:

- Educators should vary their teaching methods to encompass lectures, discussions, hands-on activities, and visual presentations. Incorporating different delivery styles not only caters to varied learning preferences but also keeps students engaged.

7. Personalized Learning Plans:

- Develop individualized education plans (IEPs) that outline specific goals and tailored strategies for each student with special needs. This personalization ensures that learning activities align with the students' capabilities, promoting growth and success in biology.

8. Professional Development for Educators:

- Provide training and resources for teachers to better understand the needs of students with disabilities. Professional development workshops can equip educators with the tools and strategies necessary to create an inclusive environment.

Conclusion

The optimization of educational materials in biology for students with special needs is a vital component of inclusive education. By implementing varied teaching strategies, utilizing technology, and designing materials that cater to diverse needs, educators can create a supportive and enriching learning environment. Inclusive education ultimately benefits all students by promoting understanding, empathy, and collaboration, which are essential skills in today's diverse and interconnected world. As we continue to refine our approaches to biology education, it is essential to advocate for practices that embrace inclusivity, ensuring that all students have the opportunity to thrive in their academic journeys.

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Pharmaceutical sciences

NEUTRAL LIPIDS OF AMYGDALUS COMMUNIS (NONPAREIL) CULTIVATED IN GEORGIA

B. Kikalishvili¹
Ts. Sulakvelidze¹
M. Getia¹
M. Puladze¹
M. Malania¹

¹Tbilisi State Medical University Ivel Kutateladze Institute of Pharmacochimistry,
36 P. Sarajishvili Street, 0159, Tbilisi, Georgia

Introduction. The sum of neutral lipids with a yield of 32% was obtained from air-dry seeds of *Amygdalus communis* (Nonpareil) and its major classes were identified. Besides, some of their physicochemical characteristics were determined, such as specific gravity, refractive index, acidity number, iodine number, and saponification number.

Based on the study results, new lipid-containing plant resources will be identified and studied in the future to use in medical practice and cosmetology.

Aim of research. The aim of the research was to study the neutral lipids (N/L) of air-dry seeds of *Amygdalus communis* (Nonpareil) cultivated in East Georgia.

Materials and methods.

Plant material. *Amygdalus communis* (Nonpareil) seeds were collected by the staff of the Pharmacobotany Department of the Phytochemistry Research Department of the Institute of Pharmacochimistry in east Georgia, Bodbe, on 21.09.2022. [1,4,5,6,7,8,9].

Gas chromatography-mass spectrometry (GC-MS). Saturated, unsaturated, and polyunsaturated fatty acids were qualitatively and quantitatively identified in *Amygdalus communis* (Nonpareil) seed oil using the method of gas-liquid chromatography. GC-MS analysis of fatty acids was carried out with an Agilent Technologies 7890B GC-MS instrument equipped with a split/splitless injector and an autosampler. HP-5ms Ultra Inert (30m × 250µm × 25µm) capillary column was used for sample separation, and a mass spectrometer was used for detection. Injector temperature: 280°C; detector temperature: 280°C; initial column temperature: 150°C for 2 min.; 150°C - 195°C (15 C/min); 195°C for 5 min.; 195°C - 205°C (4 C/min), 205°C for 5 min. 205°C - 211°C (4 C/min), 211°C for 5 min. Transfer line temperature: 280°C. Split value 200. The obtained results were treated with the NIST database to identify the components.

Obtained results. The sum of neutral lipids with a yield of 32% was obtained from air-dry seeds of *Amygdalus communis* (Nonpareil) seeds by cold press extraction, and its main classes were identified qualitatively: hydrocarbons, fatty acid esters, triglycerides, free fatty acids, and sterols.

The following physicochemical constants of cypress seed oil were determined: specific gravity 0.914, refractive index 1.472, acidity number 1.11, iodine number 98, and saponification number 197.

Gas-liquid chromatography was used to qualitatively and quantitatively identify the following fatty acids in *Amygdalus communis* (Nonpareil) seeds oil: 9-hexadecenoic acid 0.49%, hexadecanoic acid 9.02%, 9-octadecanoic acid 78.23%, methyl stearate 3.83%, eicosanoic acid 0.12%, docosanoic acid 0.02% [2,3].

Conclusion. According to the obtained results and literature data, seeds of *Amygdalus communis* (Nonpareil) and its oil is rich in saturated, unsaturated, and polyunsaturated fatty acids and carotenoids, which make it possible to use it in medical practice and cosmetology in the future.

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Philological sciences

WAYS OF COMPREHENSIVE TRAINING OF FUTURE RUSSIAN LANGUAGE TEACHERS AT THE UNIVERSITY

Fayzullaeva Zulfizar
Asian University of Technology

Abstract

This article is devoted to the problem of comprehensive training of a specialist in the field of language teaching. Material is presented on the problems of developing professional competencies of university students when studying the discipline "Practical course of the Russian language". The features of the formation of communicative, cognitive, creative competence in the classroom using a person-oriented approach in the process of learning Russian as an additional language and the development of individual creative resources are described in detail.

Keywords. *competencies, comprehensive training, creative development, philological sciences*

Introduction.

Modern society places increasingly high demands on the training of students, and priorities are aimed at the quality of education. Transformations have taken place in the educational system. The development of new educational programs is associated with the formation and development of competencies, with the main attention being paid to a practice-oriented approach in organizing the educational process. Transformations in the education system are primarily associated with the use of a competency-based approach to organizing the educational process in the training of competitive specialists. The acquisition of professional competencies is realized both in the study of individual academic disciplines, cycles, modules, and in the development of didactic units that are integrated into general professional and special disciplines.

The general goal of comprehensive training of specialists in the field of languages includes the development of students' ability for intercultural communication, the formation of readiness, based on a developed motivational sphere, to creatively carry out their communicative activities, while demonstrating professionally significant personal qualities.

Literature review.

There are variant interpretations of the concept of "competence". In particular, in Ozhegov's explanatory dictionary "competent - knowledgeable, knowledgeable, authoritative in any field." The concept of "professional competence" includes knowledge, abilities, skills, combining them with professional motives, abilities, attitudes of a specialist's personality, his social behavior, opportunities for self-realization and self-expression in the professional field. Mastery of competence creates the basis for the development of productive ways of acting and adaptability to new situations.

Various competencies are the basis for the development of competence, which, in a general sense, presupposes an employee's awareness of his professional activity and the ability to implement it on the basis of knowledge, skills, and technology skills.

A special approach to the educational process when mastering educational material has a positive psychological effect on students as they solve relevant educational problems, namely, it promotes the activation of speech and thought processes, increasing the creative activity of students, activates involuntary attention and memorization, stimulates interest in the Russian-language language being studied and reinforced information, makes it possible to motivate speech actions and actions, increasing the communicative significance of tasks, and creates a feeling of a real language environment.

Materials and methods.

Exploring the concepts of "competence", "competence" with the linguistic speech activity of students, as well as with their professionally oriented, creative and cognitive joint educational activities, we propose the concept of "linguo-pedagogical competence", the structure of which consists of three interrelated and interdependent competencies: communicative, cognitive and creative.

The communicative competence of students ensures the success of the main tasks of communication and self-realization of the individual, and is expressed in the possession of linguistic skills,

compliance with specific socio-cultural norms of speech behavior and psychological laws of establishing contact between communicating, maintaining a favorable atmosphere for the development of the emotional and sensory sphere of the individual.

In the educational process, important pedagogical conditions for the formation of students' communicative competence include the following:

- speech development based on data reflecting the real picture of students' speech activity;*
- use of grammatical categories of text in the classroom to construct monologue and dialogic speech; – актуализация в речевых ситуациях знаний студентов в специальной области;*
- the use in speech activity of techniques for forming the lexical minimum of a situation in specialization using individual and group approaches in teaching methods;*
- organization of speech activity taking into account future professional activities.*

Mastery of all components of communicative competence requires the development of the student's personal qualities that ensure effective interaction with other students - communication partners.

Communicative competence, considered in the pedagogical aspect, includes the independence of the student's personality, his activity, empathy, tolerance for a different way of thinking, the desire and ability to see and understand the differences and commonalities in cultures, in the worldview of their carriers. This competence presupposes the ability of students to conduct discussions, ask questions on the essence of the problem, build a dialogue with a partner, as well as developed skills of working in a group or team.

A university teacher must take into account that in the educational process when studying a language, it is important to include approaches to modern students that give high-quality results that could be further implemented in professional activities. Russian language classes must be structured based on the individual characteristics of students, that is, using a focused approach to each of them. Therefore, the direction of language learning is chosen by the teacher taking into account the student's future profession.

The process of learning a language is characterized not only by the development of students' communicative abilities, but also by the improvement of knowledge, intellectual properties of the individual, and understanding of the deep processes that occur in the language. The core of cognitive competence consists of well-developed memory, thinking, and general intelligence. Cognitive competence is ensured by the developed skills of systematization and extrapolation of educational and scientific information, skills of participation in collective and individual cognitive search, analysis of phenomena in a foreign language and comparison of these phenomena with similar ones in the native language.

Cognitive competence also involves the development of the following intellectual abilities:

- repeat or paraphrase the interlocutor's remarks to confirm understanding of his statement/question;*
- seek help from your interlocutor (clarify the question, ask again);*
- switch the conversation to another topic.*

These abilities develop in students the desire to discover new areas of practical application of the language they are learning, and cultivate a tolerant attitude towards foreign language speech behavior and towards the interlocutor on the basis of empathy. Thus, the relationship between cognitive and communicative competencies is obvious, which is reflected in the concept of "intellectual communication." It is defined as the ability of a group to easily and quickly find a common language in discussing different points of view, to come to a common opinion in the process of searching for a common solution. Communication in joint educational and cognitive activities contributes to the acquisition of certain social experience by students.

Thus, cognitive competence is expressed in the close relationship of language learning as a means of interpersonal and intercultural communication with the intensification of intellectual skills and abilities.

Activation of the processes of intellectual development of students contributes to creative mastery of the methods of modern science, i.e. cognitive competence is closely intertwined with creative competence, manifested in creative abilities that determine the measure of success and effectiveness of students' activities, the degree of productivity of personality manifestations as a subject of activity.

As is known, creative abilities originate in individual activity and develop in collective activity, i.e., the "creative-communicative" feature of students is that when learning to communicate in another language, they have to take a creative approach to processing information, choosing strategies and

tactics communication with communication partners, linguistic and emotional means of expressing one's own opinion, attracting attention to one's position, persuading listeners during discussions.

Creativity in the joint educational activities of students is manifested in a collective search, the creation of a new product (previously unknown scientific knowledge, project, production, etc.). So, an integrated approach to the training of modern foreign language specialists at a university involves the formation of linguistic and pedagogical competence in students, represented by communicative, cognitive and creative competencies.

For the successful development and formation of the student's listed competencies, it is necessary to pay great attention to the dynamics of the motives of educational activity. The need for knowledge of the Russian language as a leading component of motivation is an internal condition, a stimulus for activity.

Consequently, the motives for students' educational activities can be divided into cognitive, achievement and social motives. The first group of motives includes the desire to acquire new knowledge and ways of obtaining this knowledge, and to independently improve methods of acquiring knowledge. Achievement motives are characterized by the desire to achieve creative success in the educational process for further implementation in professional activities, and these motives develop in the process of solving creative problems.

In classes, it is necessary to use a practice-oriented approach, to include topics from the life of the student himself and the situations that he encounters in reality. Particular attention is paid to nonverbal means of communication that accompany the speech situation, while the level of language proficiency of students must be taken into account.

Among the tasks facing a Russian language teacher when organizing work with students, two are especially important. The first, most relevant, is to teach the student the correct pronunciation, intonation, use of words and their forms, the construction of phrases and sentences, compliance with the drill norms of the language, and to achieve automaticity in the correct use of language units, which is especially important at the beginning of language learning. The second is to instill the skills of correctly constructing written and oral texts, using vocabulary to construct monologue and dialogic speech, including speech situations in a professional environment. During the lesson, the teacher needs to find modern methods of explaining complex linguistic phenomena.

Research results.

In Russian language classes, various pedagogical technologies are used, and a person-centered approach is applied to each student. In the pedagogical activity of a teacher, this methodological orientation allows, relying on interrelated pedagogical methods of action, to ensure and support the processes of self-education, self-development and self-realization of the student. The greatest interest in the educational process, in our opinion, is precisely reading textual material, in which one can not only master the features of the Russian language, but also master phonetic and lexical types of speech activity. When reading the text material, the student receives the information he needs.

At the initial stage of learning the Russian language, text material is first read aloud by the teacher. To facilitate the perception of new material, so that students understand what is being said in the text, it is necessary to carry out vocabulary work and introduce new words. This work is carried out so that the student remembers words whose meaning he already knows. We also need to remind you about the grammatical structures of the text. Full understanding of a sentence occurs only when the student has familiar words and phrases in stock.

To ensure that the student understands the text material read, you can use the reading technique developed by the methodologists, which includes the following points: at the beginning of the lesson, the teacher's demonstrative slow reading (no more than 120 words per minute); then fluent reading (words, phrases, sentences and paragraphs of text); repetition – expressive and exemplary reading. At the same time, students can also demonstrate expressive reading in class.

Including reading into the teaching methodology as one of the effective methods of learning the language, special attention should be paid to the phonetics of the Russian language, which poses a great difficulty for students. For this reason, in the classroom, the teacher must devote time to conducting such approaches as phonetic repetitions of sounds, syllables, words, phonetic dictations, and practicing various exercises for training and setting sounds when pronouncing words in Russian. When organizing a lesson, training the articulatory apparatus should be constant, especially at the initial stage of language learning.

Additional materials on specialization and specially selected texts provide opportunities for multi-aspect work with them, starting with training exercises and ending with constructing and organizing

discussions in class. When choosing a text for reading by students, they need to take into account their level of language proficiency and adhere to the principle "from simple to complex."

Conclusion.

The essence of the above comes down to the fact that the texts in the proposed reading textbooks have a developmental motivation. The educational material is presented problematically and is offered not only for memorization, but also for organizing mental activity.

A student-oriented approach involves changing the organization of the lesson structure, i.e. language learning is creative communication and problem-based discussion. First, we pose a question for the whole group, then we apply an individual approach to each student.

In the educational process of a university, the formation and development of students' professional competencies is closely related to their successful mastery of linguistic and pedagogical competence - learning outcomes depend on this. In the educational process, we pay great attention not only to practice-oriented reading, but also to the development of a system of exercises aimed at developing communicative, cognitive, and creative competencies in the field of professional communication. When offering various thematic exercises, it must be taken into account that they should always be close to a real professional situation.

From what was said earlier, it follows that in order to implement a professionally-oriented approach to studying the Russian language in the educational process of a university, it is necessary to develop such pedagogical technologies that could help create conditions for the self-actualization of the individual. To do this, it is necessary to develop teaching tools (including textbooks and teaching aids) that would reflect the principles of a professionally oriented approach.

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SOCIAL MEDIA AND ITS IMPACT ON ENGLISH LANGUAGE USE

Mammadova Svetlana Nasib kizi

Ph.D, Docent of Foreign Languages Center
Azerbaijan State Pedagogical University Baku, Azerbaijan

Abstract

Social media has transformed communication, shaping the way English is used globally. Platforms like Twitter, Facebook, Instagram, TikTok, and Reddit have introduced new linguistic patterns, slang, and abbreviations, influencing both formal and informal English. This paper explores the impact of social media on English language use, analyzing its positive and negative effects on vocabulary, grammar, and communication styles.

Keywords: English education, speech recognition, social media, language acquisition

Introduction

Social networks as one of the ICT tools contribute to the resolution of a large number of problems that arise in the conditions of modern realities. Thanks to the use of social networks, an accessible educational environment is formed in which the educational content material is presented in a format that is most effective and accessible to representatives of different generations of the modern world [1]. In addition, the above-mentioned tool, which refers to information and communication content technologies, is a catalyst for the implementation of cognitive activity, as well as the consistent development and improvement of formed knowledge, skills and abilities, and also provides a positive motivational system and increases the interest of students in free access on various social networking platforms [2].

Since this research paper focuses on the use of two social networks as one of the methods of studying a foreign language, it can be concluded that the educational process using this tool represents two main forms of communication interaction with the recipient of information. The first form can be telecommunication and information resources. The main resources of the first category in the context of studying a foreign language through social networks can be various live broadcasts, chats, forums, conferences, comments, responses to various forms of material broadcasting, the initial task of which is to implement mutual communication between users who are at a certain distance from each other. These tools are used to develop communicative competence, as well as to consciously create a communicative situation necessary to improve communication skills in a foreign language. At the same time, when directly examining information resources within social networks, we can identify various resources that contain educational material in the form of text, audio or visual presentation on various thematic areas in a specific foreign language.

Social networks can be used as one of the effective additions to the educational process in developing skills and abilities of grammatical and lexical content by watching educational videos or reading informative posts on certain platforms [3]. The use of aspects of the Internet (in our case, directly social networks) today is an indispensable tool for learning a foreign language, thanks to which, within the framework of the created virtual environment, the student gets the opportunity to perceive information outside of time and local frameworks in the process of forming an independent study of a foreign language based on their own communicative and social interests and desires.

Based on the study of information resources and research sources, we have identified potential reasons that contribute to the use of various aspects of information and communication technologies in the process of learning a foreign language. The main prerequisites include the following: 1) today, the use of Internet resources involves the formation of favorable conditions for increasing motivation and enhancing the interest of students in the process of learning foreign languages. In addition, consistent perception of educational material presented online, 2) contributes to the improvement of all linguistic aspects, and 3) creates the most comfortable conditions directly for the student himself, which consist in the absence of stress when learning a foreign language in personal contact or in a group format.

Thus, based on the information presented above, we can highlight the main advantages of using social networks in the process of learning a foreign language. First of all, this phenomenon contributes to 1) the emergence of the opportunity to study any foreign language depending on the preferences of students outside the spatial and temporal frameworks that represent their educational institutions. In

addition, directly thanks to social networks 2) various foreign language competencies of socio-cultural, speech, text and communicative content are formed. 3) The acquisition of new knowledge, skills and abilities in the process of learning a foreign language online in social networks is carried out free of charge or with minimal material costs, and also provides completely 4) free access to various materials of any subject area, based on the wishes of the student. It could also be emphasized that 5) social networks provide an advantage in learning a foreign language for people with disabilities.

The Role of Social Media in Language Evolution

Social media encourages casual communication, leading to language simplification. Users prefer shorter sentences, informal expressions, and direct messaging to facilitate quick interactions. Social media has introduced neologisms like "selfie," "meme," and "hashtag." Words evolve rapidly, reflecting digital culture and online trends. Emojis and GIFs complement written text, adding emotional and contextual meaning to conversations. They serve as a universal language, reducing the need for detailed explanations.

Positive Effects of Social Media on English Language Use

Social media platforms connect English learners with native speakers through discussion forums, language exchange groups, and educational content. Non-native speakers engage with English content daily, improving their reading and comprehension skills through posts, tweets, and videos. Social media facilitates cross-cultural communication, allowing users to adopt diverse linguistic expressions and idioms from different English-speaking communities.

Negative Effects of Social Media on English Language Use

Frequent use of abbreviations, misspellings, and non-standard grammar affects formal writing and professional communication.

Shortened words like "u" (you), "brb" (be right back), and "omg" (oh my god) infiltrate academic and professional writing, undermining language structure. Casual communication reduces adherence to punctuation and capitalization rules, affecting literacy and writing proficiency. Content creators introduce slang and catchphrases that become part of mainstream English. Memes contribute to language evolution, reinforcing new expressions and humor-based communication. Online communities develop unique language conventions, such as "leet speak" and "internet acronyms."

Code-Switching and Multilingual Communication on Social Media

Social media fosters bilingual and multilingual interactions, with English serving as a bridge language. Users blend English with native languages, creating hybrid expressions like "Spanglish" and "Hinglish." Constant exposure to mixed-language content influences language proficiency and fluency. Educators integrate social media trends into language curricula to enhance student engagement. Analyzing tweets, hashtags, and viral videos helps students understand modern English usage. Promoting responsible language use online ensures that students maintain professional writing standards.

Social networks are gaining popularity as new users of different ages decide to become part of the virtual world or use it for work. We are interested exclusively in the educational environment and the use of the Internet in it. For this, we will need the most representative social networks among young people. This means the possibility of receiving exclusively educational content and the way it is presented.

According to statistics [4], the most popular networks among Russians in 2020 were VKontakte, Facebook, Instagram, Odnoklassniki, YouTube, and TikTok, respectively. However, the first network is a combination of a messenger, forums, conversations, and groups for communication and publishing information. The first aforementioned social network has a geographic focus on representatives of Russia and the CIS. The same conclusion can be made about the Odnoklassniki network, which, in addition to a similar territorial focus, also implies communication between representatives of the middle and older generations. Facebook, like VKontakte, is more focused on direct communication with people than on the creation and storage of educational content, and YouTube is not a network, since it is a video hosting service. Despite the fact that users of this service write and read comments under published videos, this platform is more about one-way communication in the form of publishing videos, rather than the process of communicating with subscribers.

Therefore, we will rely on the remaining two social networks, in which educational content is widely quoted. Instagram today is a popular social network in which you can post your content using posts (photos and videos with descriptions) or stories (photos or videos that last 15 seconds, in a daily feed) [5].

It has many official pages with educational content. The BBC: Learning English radio, known to many in the past, also created a new channel on Instagram and is now based there or in its application. To popularize the English language, two or three posts are posted daily, and various kinds of rubrics are

maintained in the stories on this page. Among the subscribers, you can find both elderly residents of third world countries and teenagers.

You can find authentic materials for French, Spanish, Italian, as this network is convenient for educational purposes. Live broadcasts, long videos saved in a profile (individual page), allow speakers to hold free conferences, webinars and meetings.

Considering the retrospective of the formation of the TikTok platform, it is important to note that it is the newest social network, which was launched in the summer of 2018 [6]. Today, this video platform is one of the fastest growing and downloaded applications and has more than 1 billion users from one hundred and fifty countries. TikTok is initially an entertainment social network, which is gradually becoming educational [7]. Personal educational and cognitive pages appear, the purpose of which is to gain popularity by people, teachers are beginning to actively use the network to attract clients.

The above social networks solve the problems of education. First, let's look at the difficulties that participants in the educational process face before we begin to analyze the effectiveness of social networks.

Conclusion

Social media significantly influences English language use, introducing new vocabulary, altering grammar norms, and reshaping communication patterns. While it offers opportunities for language learning and global interaction, it also poses challenges for maintaining linguistic accuracy. Future research should explore the long-term effects of social media on literacy and the evolution of digital communication in English.

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Technical sciences

DIGITAL TOOLS FOR TEACHING DIGITAL LITERACY IN INCLUSIVE EDUCATION

Zhuldyz Baizhumanova

*Master's student, Abai Kazakh National Pedagogical University
Almaty, Kazakhstan*

ABSTRACT

Inclusive education emphasizes equal opportunities for all learners, including those with special educational needs (SEN). In the digital age, teaching digital literacy has become a fundamental component of early education. However, adapting digital tools for students with diverse abilities remains a challenge, particularly in inclusive classrooms. This paper explores how digital tools can be effectively used to teach digital literacy in primary school settings that include students with visual and hearing impairments. The research is based on a literature review and analysis of current inclusive teaching practices. Key tools such as screen readers, speech-to-text software, captioned video platforms, and universal learning design (UDL) frameworks are examined. The study also considers practical challenges faced by educators, including the lack of training and limited access to assistive technologies. Based on this analysis, the paper offers a set of practical recommendations for integrating digital tools into inclusive classrooms. These include teacher training strategies, the use of project-based approaches, and the creation of inclusive digital resource libraries. By implementing these methods, educators can create equitable digital environments that promote participation, engagement, and digital competence for all learners. This research contributes to the growing body of knowledge on inclusive digital education and aims to support educators in designing more accessible, personalized, and effective learning experiences.

Keywords: *inclusive education, digital literacy, digital tools, SEN students, primary school, educational technology*

1. Introduction

In recent years, inclusive education has gained significant attention as a human-centered and rights-based approach that ensures the participation of all students in the learning process, regardless of their physical, cognitive, or sensory abilities. The transition to inclusive practices has led educators to rethink not only what is taught, but also how it is taught, with a growing emphasis on accessibility, flexibility, and the individual needs of learners. At the same time, the rapid integration of digital technologies into education has made digital literacy a core competence for 21st-century learners. Students are expected to navigate digital environments, use technology responsibly, and develop critical thinking and communication skills within digital contexts from an early age.

However, students with special educational needs (SEN), particularly those with visual or hearing impairments, often face challenges in accessing digital learning content. These barriers risk excluding them from fully participating in the digital learning process. Addressing this issue requires the use of inclusive digital tools that are not only accessible, but also responsive to learners' diverse needs. This paper examines the types of digital tools that support digital literacy instruction in inclusive classrooms, with a specific focus on primary school learners. It also explores practical strategies for implementation and integration, aiming to assist educators in designing equitable digital learning environments that foster engagement, participation, and skill development for all students.

2. Theoretical Background

Inclusive education is a pedagogical approach aimed at ensuring equal access to quality education for all learners, regardless of physical, sensory, or cognitive differences. It is grounded in principles of equity, participation, and respect for diversity. Central to this approach is the integration of students with special educational needs (SEN) into mainstream classrooms, emphasizing not just their presence but their active engagement.

The term "SEN" encompasses a wide spectrum of disabilities and learning challenges, but this study focuses specifically on students with visual and hearing impairments. These learners frequently face barriers in accessing educational materials—particularly in digital environments where visual and

auditory information dominates and where tools are often not adapted to their specific needs (Hasselbring & Glaser, 2012). At the same time, digital literacy has emerged as a key 21st-century competency. It involves not only the technical use of digital tools but also the development of critical thinking, creativity, and adaptability. This dual focus—on both inclusivity and digital fluency—is essential for preparing all learners to participate meaningfully in today's digital society.

Integrating digital literacy into inclusive education creates both challenges and opportunities. For example, project-based approaches have proven effective in increasing engagement among SEN students (KazNPU, 2022). For students with visual impairments, screen readers, audio descriptions, and tactile feedback are essential tools. For those with hearing impairments, the inclusion of visual cues, subtitles, and sign language content is critical. Educators must therefore adopt flexible, student-centered approaches to ensure that digital learning is both accessible and empowering. As Asanova (2017) emphasizes, inclusive education should create conditions in which students with SEN are not only included but also supported and empowered. This theoretical foundation underscores the need for carefully selecting and adapting digital tools to match learners' diverse sensory needs and to promote equal digital participation.

3. Digital tools for inclusive education

To ensure the successful teaching of digital literacy in inclusive classrooms, educators must thoughtfully integrate digital tools that support students with various needs. In particular, students with visual and hearing impairments often encounter unique challenges in accessing digital content, which necessitates adaptive and accessible technological solutions.

Students with sensory impairments benefit from specialized tools designed to address their specific learning needs. For learners with visual impairments, screen readers such as JAWS or NVDA convert on-screen text into speech, enabling independent navigation. Voice-command systems like Apple VoiceOver or Google Assistant offer hands-free interaction, while Braille displays and tactile graphics support comprehension of non-verbal content. Audio-based resources such as podcasts and audiobooks provide alternative engagement. These assistive technologies are essential components of accessible ICT for visually impaired students, providing the foundation for equal participation in digital learning environments (Douglas & Pavey, 2010). For hearing-impaired students, tools that prioritize visual input—like captioned video platforms (e.g., YouTube with subtitles, Edpuzzle), sign language-supported content, and speech-to-text software such as Otter.ai or Google Live Transcribe—enhance accessibility and comprehension.

Additionally, universal tools that are designed with built-in accessibility features can support a broader range of learners. Platforms like Google Workspace for Education and Microsoft Immersive Reader include options such as screen reading, voice typing, real-time captions, and text simplification. Programming platforms like Scratch and Code.org offer visual, block-based interfaces that are intuitive for diverse learners and promote engagement in digital content creation from an early age.

In practice, the effectiveness of these tools is closely tied to how educators implement them in lesson planning. For example, a screen reader may support reading tasks, but additional tactile or auditory aids may be needed for interpreting charts or media content. Similarly, visual subtitles might be insufficient unless combined with sign language or visual cues for hearing-impaired students. Thus, thoughtful instructional design that combines multiple modes of communication is essential for full inclusion.

Finally, teacher preparedness plays a crucial role in the successful integration of digital tools. Without proper training in both inclusive pedagogy and digital technologies, even the most advanced tools may remain underutilized. Educators must be equipped not only with technical knowledge, but also with strategies to personalize digital resources and ensure cultural and linguistic relevance. By combining inclusive planning, proper implementation, and meaningful tool selection, digital literacy education can become a powerful enabler of equity and participation for all learners.

4. PRACTICAL RECOMMENDATIONS

To effectively integrate digital tools in inclusive classrooms, educators must move beyond simple tool selection and consider pedagogical strategies that enhance their use. It is not enough to adopt technology; educators must also foster an inclusive digital culture in which all students feel empowered and supported.

One essential element is teacher preparation. Educators must be familiar with the accessibility features embedded in commonly used platforms such as Google Classroom, Microsoft Office, and educational applications. Ongoing professional development in inclusive digital pedagogy can enhance teachers' confidence and ability to differentiate instruction. As emphasized by Rose and Meyer (2002),

universal design principles are fundamental for creating accessible learning environments. Therefore, adopting the Universal Design for Learning (UDL) framework is crucial. This involves planning lessons that offer multiple means of representation (e.g., text, visuals, audio), engagement (e.g., interactive content, personalized tasks), and expression (e.g., writing, video, voice). For example, providing written instructions alongside audio explanations ensures access for both hearing- and visually-impaired students. Another key strategy is the collaborative evaluation of digital tools with students. Teachers should test tools in real classroom settings and gather feedback from students with visual and hearing impairments. This user-centered approach helps educators identify which technologies are genuinely accessible and engaging. In doing so, they can tailor their digital instruction to meet students' needs more effectively and promote active participation.

Blended learning models—those combining face-to-face and digital instruction—can also enhance inclusivity. In the context of Central Asian education systems, Nurbek, Baidildinov, and Sakhipov (2024) emphasize that ensuring the accessibility of modern digital tools remains a challenge, particularly for students with limited access to assistive technologies. To address this, teachers can prepare video lessons with subtitles, offer extended time for assignments, and develop personalized content tailored to individual abilities. As Baymoldaeva (2017) notes, ICT enables students with special needs to participate more fully by supporting their unique learning styles and increasing motivation.

Lastly, schools should invest in the development of inclusive digital resource libraries. These collections may include curated educational apps, accessible materials, sign language videos, and audio tutorials. According to UNICEF (2021), building a structured assistive technology framework in schools improves both access and consistency. Centralizing such resources not only simplifies the teaching process but also ensures long-term sustainability and equal opportunity for all learners.

5. CONCLUSION

In the context of modern education, teaching digital literacy is no longer optional — it is essential for preparing students to succeed in a digitally connected and information-rich society. In inclusive classrooms, digital tools hold the power to bridge learning gaps, promote equal opportunities, and empower all learners, including those with visual and hearing impairments.

This paper has explored the significance of selecting accessible, adaptable, and user-friendly digital tools tailored to the diverse needs of students with sensory disabilities. By analyzing tools such as screen readers, speech-to-text software, visual platforms, and universal learning design frameworks, we demonstrated how technology—when thoughtfully integrated—can foster equitable and effective learning experiences. Furthermore, the practical recommendations presented here aim to support educators in implementing inclusive digital practices, emphasizing the value of professional development, differentiated instruction, and student-centered strategies.

Ultimately, inclusive digital education fosters a learning culture grounded in participation, belonging, and equity. By equipping students with digital competencies through accessible tools and inclusive pedagogy, educators can serve as catalysts for positive transformation—helping to build a more inclusive, empowered, and future-ready generation of learners.

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THE IMPACT OF ARTIFICIAL INTELLIGENCE ON PROJECT MANAGEMENT

Ansar Amrin

Master's student,
Astana IT University, Astana city, Kazakhstan

Abstract

The growing integration of Artificial Intelligence (AI) into project management represents a significant shift in how contemporary projects are planned, executed, and evaluated. This research explores the extent to which AI technologies influence various aspects of project management, including efficiency, decision-making, risk mitigation, and the evolving responsibilities of project managers. A mixed-methods approach was employed, combining qualitative thematic analysis and secondary quantitative insights drawn from peer-reviewed literature published between 2020 and 2024. The analysis focused on identifying how AI tools contribute to the five PMBOK process groups—Initiating, Planning, Executing, Monitoring and Controlling, and Closing—through enhancements in forecasting, resource allocation, task automation, and real-time performance tracking. The findings reveal that AI significantly improves operational efficiency by automating repetitive tasks and optimizing resource distribution. Predictive analytics and machine learning algorithms are found to enhance early risk identification, enabling proactive mitigation strategies that support overall project stability. In addition, AI-driven decision support systems allow project managers to make more informed, objective, and data-centric decisions, moving the profession toward a more strategic and analytical direction. As a result, the role of the project manager is evolving from operational task management to high-level oversight that involves interpreting AI outputs, managing human-AI collaboration, and ensuring ethical compliance in decision-making processes. Despite these advances, several barriers hinder full-scale AI adoption, including issues related to data quality, system integration, workforce readiness, and resistance to technological change. The successful implementation of AI in project management is shown to depend not only on the maturity of the technology itself but also on the organization's cultural and structural preparedness. The study also emphasizes the need for project managers to acquire digital competencies and soft skills that complement the analytical power of AI systems. Overall, the research confirms that AI plays a transformative role in project management by augmenting human capabilities and enhancing project outcomes across the lifecycle. However, this transformation is not without complexity, and organizations must approach AI adoption with a strategic, informed, and ethically grounded mindset. The study contributes to a growing body of knowledge that positions AI not as a replacement for human leadership but as a collaborative partner in delivering more efficient, adaptive, and successful projects.

Keywords: predictive analytics, process automation, decision support, risk mitigation, digital transformation, organizational readiness.

Introduction.

In today's rapidly evolving digital landscape, Artificial Intelligence (AI) has emerged as a transformative force across a wide range of industries, revolutionizing the way organizations operate, compete, and deliver value. As businesses increasingly seek to optimize performance, reduce uncertainty, and enhance agility, AI has become a strategic enabler of innovation and operational excellence. One professional field experiencing a growing wave of AI integration is project management, which has traditionally depended on human judgment, planning, and leadership to steer complex and dynamic initiatives toward successful completion.

Project management, by its nature, involves the coordination of multiple resources, timelines, risks, and stakeholder interests. As modern projects become more intricate, distributed, and time-sensitive, the limitations of conventional tools and human-centric methods are becoming increasingly evident. In response, organizations are turning to AI technologies to enhance project delivery capabilities, reduce administrative burdens, and improve decision-making accuracy. AI technologies—such as machine learning, natural language processing (NLP), robotic process automation (RPA), and predictive analytics—offer powerful tools for improving project outcomes. These tools support project managers by automating routine tasks, generating real-time performance insights, forecasting potential risks, and

recommending optimal resource allocations.

Despite its promise, the application of AI in project management is still in its developmental stage, and practical adoption varies significantly across industries and organizational contexts. While early case studies suggest measurable improvements in efficiency, risk mitigation, and stakeholder alignment, several unresolved issues persist. These include the ethical use of AI, transparency in automated decision-making, integration with legacy systems, and the readiness of organizations and project teams to embrace AI-powered tools. Furthermore, the evolution of AI is reshaping the very role of the project manager, who is now expected to serve not only as a planner and communicator but also as a data-literate strategist capable of interpreting AI-generated insights and leading hybrid human-machine teams.

This research aims to investigate the impact of Artificial Intelligence on modern project management. Specifically, it examines how AI contributes to improved efficiency, enhances strategic decision-making, and influences the changing role of project managers. In doing so, the study also explores the barriers to successful AI adoption and identifies the critical organizational and technical enablers that facilitate effective implementation. Through a synthesis of current academic literature and recent technological developments, this paper offers a comprehensive and structured overview of AI's growing influence on project management practices.

To guide this inquiry, the following research questions are addressed:

How does the integration of Artificial Intelligence influence the efficiency and effectiveness of project management processes?

What are the key factors that enable or hinder the successful adoption of AI technologies in project management?

In what ways does AI transform the traditional roles and responsibilities of project managers?

Literature review.

The intersection of Artificial Intelligence (AI) and project management has received considerable scholarly attention in recent years, reflecting a growing interest in the practical applications of AI to improve project efficiency, risk management, and decision-making.

AI Technologies in Project Management

AI technologies such as machine learning, natural language processing (NLP), and predictive analytics are increasingly being adopted in project management tools. These technologies enable more accurate forecasting, real-time monitoring, and intelligent automation. According to Savio and Ali (2023), AI-driven solutions offer predictive capabilities and intelligent automation that enhance traditional project management approaches by optimizing scheduling, resource allocation, and issue resolution. Similarly, Khayyat and Alshaikhi (2021) emphasized that the integration of AI enables more autonomous project management systems that reduce the cognitive burden on human managers.

Benefits of AI in Project Management

One of the most frequently cited advantages of AI is its ability to improve decision-making through the analysis of large datasets. El Khatib and Al Falasi (2021) found that AI significantly enhances the quality and speed of decisions in both single and multi-project environments by improving data integrity and enabling more informed decision-making. Ogunbukola (2024) highlighted AI's capacity to automate repetitive tasks, provide real-time insights, and support strategic decision-making in complex projects.

In a systematic literature review, Hashfi and Raharjo (2023) identified how AI supports each of the PMBOK-defined process groups—initiating, planning, executing, monitoring and controlling, and closing—by streamlining tasks and enhancing quality control, resource utilization, and project closure outcomes.

Challenges and Limitations

Despite its promise, AI adoption in project management faces several hurdles. Common challenges include data quality, algorithmic transparency, workforce resistance, and integration with existing legacy systems. Hossain et al. (2024) pointed out that organizations often struggle with aligning AI tools to conventional methodologies and suffer from limited technical expertise and data infrastructure. These barriers can impede the realization of AI's full potential.

Evolution of Project Management Roles

AI is also reshaping the responsibilities of project managers. Ruiz et al. (2020) suggested that hybrid AI models are beginning to play a decision-support role, allowing project managers to shift from operational execution to strategic oversight. As AI handles routine tasks, the role of the project manager evolves toward managing stakeholder relationships, ethical concerns, and the alignment of technology with business goals.

Future Trends

Looking forward, AI is expected to become an integral part of project management. Fridgerisson et al. (2021) found that AI will particularly influence areas such as risk, schedule, and cost management—domains that rely heavily on data analysis and forecasting. The long-term outlook is that AI will augment human project managers rather than replace them, enabling a collaborative intelligence model.

Methodology.

This study employs a mixed-methods exploratory design to investigate the impact of Artificial Intelligence (AI) on project management, integrating both qualitative and quantitative data derived from secondary sources. The aim is to identify the ways AI influences efficiency, decision-making, risk mitigation, and the role of the project manager, as well as to analyze the challenges and conditions necessary for successful adoption. By combining a systematic literature review with comparative thematic analysis, the research seeks to capture both the breadth and depth of academic and practical discourse on the topic.

Research Philosophy and Approach

The study is grounded in the pragmatic research philosophy, which values practical, real-world relevance and supports the integration of qualitative and quantitative methods. The abductive reasoning approach was adopted, allowing for iterative interplay between theory and emerging evidence during analysis. This approach was suitable given the dynamic nature of AI technologies and their evolving applications in project environments.

Research Design

The research design consists of two interlinked phases:

1. Qualitative Phase – Systematic Literature Review and Thematic Analysis

A review of scholarly literature was conducted to examine conceptual frameworks, use cases, and implementation challenges of AI in project management. The review followed a structured protocol inspired by Costa et al. (2022) and Hashfi and Raharjo (2023), ensuring comprehensive coverage across PMBOK-defined process groups. Articles were then analyzed thematically to identify patterns, practices, and emerging issues.

2. Quantitative Phase – Secondary Data Interpretation and Comparative Mapping

Quantitative insights (e.g., survey data, metrics, performance comparisons) extracted from published articles (e.g., El Khatib & Al Falasi, 2021; Hossain et al., 2024) were used to interpret the impact of AI tools on project outcomes, such as time, cost, risk reduction, and resource optimization. This data was mapped against project process groups and knowledge areas to explore where AI produces the most value.

Data Collection and Selection Process

A total of 10 peer-reviewed journal articles published between 2020 and 2024 were selected. The search was conducted across databases such as IEEE Xplore, ScienceDirect, MDPI, SCIRP, and ResearchGate using keywords including: "Artificial Intelligence in Project Management," "AI adoption in PM," "AI tools in PMBOK," and "AI and decision-making."

Inclusion Criteria:

- Peer-reviewed articles and systematic reviews published in English.
- Publications focused on AI applications in project management.
- Papers addressing implementation strategies, outcomes, and limitations.
- Studies aligned with PMI's PMBOK structure or discussing project knowledge areas.

Exclusion Criteria:

- Non-academic articles or opinion pieces.
- Studies unrelated to project management (e.g., generic AI/IT papers).

Data Analysis Procedures

Thematic coding was conducted manually and cross-validated. Major themes included: AI tools and technologies, organizational readiness, PM process improvement, ethical considerations, and project manager role evolution.

Comparative analysis was used to map AI impacts across PMBOK process groups: Initiating, Planning, Executing, Monitoring & Controlling, and Closing (Hashfi & Raharjo, 2023).

Technical categorization was guided by Shoushtari et al. (2024), who outlined the application of neural networks, hybrid systems, and fuzzy logic techniques in project environments.

A matrix model was developed to align AI techniques (e.g., machine learning, predictive analytics) with project outcome indicators (e.g., cost reduction, risk mitigation, schedule adherence).

Validation and Rigor

To enhance trustworthiness, a triangulation strategy was employed:

- Comparing findings across multiple authors and disciplines.
- Cross-referencing process group impacts with knowledge area observations.
- Verifying consistency between conceptual discussions and empirical results (e.g., case studies and survey findings).

Ethical Considerations

This research relies exclusively on publicly available secondary data and academic publications. All sources are properly credited. No human participants were involved; therefore, formal ethics approval was not required. However, care was taken to avoid misrepresentation, bias, or plagiarism.

Methodological Limitations

- Lack of primary data: No direct surveys or interviews were conducted due to the study's scope and time constraints.
- Potential publication bias: Most of the reviewed articles reported positive outcomes, possibly underreporting failed implementations.
- Generalizability: As findings are drawn from various industries and countries, the results may not fully reflect the context of a specific sector or region.

Results and Findings.

The findings of this research highlight the multifaceted impact of Artificial Intelligence (AI) on project management across various domains, drawing from systematic literature analysis and comparative evaluation of secondary data. The results are categorized according to key project performance areas and mapped to the PMBOK process groups for structured interpretation.

1. Enhanced Efficiency and Automation

AI significantly contributes to the automation of routine project tasks, thereby improving operational efficiency and freeing up project managers to focus on strategic responsibilities. Studies by Ogunbukola (2024) and Hossain et al. (2024) indicate that AI tools such as intelligent schedulers, automated reporting systems, and resource optimization algorithms reduce administrative workload and project delays. In particular, machine learning algorithms support real-time adjustment of schedules and resource assignments based on dynamic project conditions.

- Relevant PMBOK groups: Planning, Executing, Monitoring & Controlling
- Key outcomes: Time savings, streamlined workflows, improved productivity

2. Improved Risk Management and Predictive Capabilities

Predictive analytics powered by AI enhances risk detection and mitigation. AI systems are capable of identifying patterns from historical project data, enabling early warning mechanisms for potential delays, cost overruns, and resource conflicts. According to Hashfi and Raharjo (2023), AI contributes meaningfully to risk assessments in the Initiating and Monitoring phases, where project feasibility and performance tracking are most critical.

- Key techniques: Predictive analytics, anomaly detection, scenario simulations
- Key benefits: Proactive risk mitigation, better contingency planning

3. Data-Driven Decision-Making

Findings from El Khatib and Al Falasi (2021) reveal that AI-enabled decision support systems improve decision quality through data integrity and analytical rigor. AI can analyze vast amounts of structured and unstructured project data to provide actionable insights. Neural networks and fuzzy logic models (Shoushtari et al., 2024) were identified as powerful tools for complex decision environments where traditional human intuition may fall short.

- Use cases: Budget forecasting, stakeholder analysis, performance evaluation
- Impacts: Reduced decision-making bias, improved accuracy and objectivity

4. Transformation of the Project Manager's Role

AI adoption is reshaping the responsibilities and required competencies of project managers. Rather than managing detailed administrative tasks, managers are shifting toward roles as strategic facilitators, ethical overseers, and AI collaborators. Ruiz et al. (2020) and Fridgeirsson et al. (2021) emphasized that project managers must now interpret AI-generated data, manage human-AI collaboration, and guide technological adoption within their teams.

- Implication: Need for digital literacy, soft skills, and ethical awareness
- Trend: Hybrid leadership models and augmentation (not replacement) of human roles

5. Barriers to Successful AI Adoption

Despite the positive outcomes, several barriers persist. Hossain et al. (2024) and Savio & Ali (2023)

identified challenges such as data quality, legacy system integration, high implementation costs, lack of staff training, and resistance to change. Additionally, ethical concerns related to algorithmic transparency and accountability limit the widespread deployment of AI in sensitive project domains.

- **Common challenges:**

- Incomplete or poor-quality data
- Organizational resistance and skills gap
- Ethical ambiguity in AI-driven decisions

6. Alignment with PMBOK Process Groups

Based on the framework outlined by Hashfi and Raharjo (2023), the role of AI across each of the five PMBOK process groups has been systematically mapped. The results demonstrate that AI contributes uniquely to each stage of the project lifecycle — from risk analysis in the Initiating phase to knowledge retention during project closure. A summary of these contributions is presented in **Table 1** highlighting how AI enhances both operational efficiency and strategic decision-making across the PMBOK structure.

Table 1.

AI Contributions Across PMBOK Process Groups

Process Group	AI Contributions
Initiating	Risk prediction, feasibility analysis
Planning	Cost/time estimation, resource optimization, stakeholder sentiment analysis
Executing	Automation of task assignments, scheduling, communication assistants (e.g., chatbots)
Monitoring & Controlling	Real-time performance tracking, anomaly detection, adaptive forecasting
Closing	Documentation automation, success evaluation, knowledge capture

Discussion.

The findings of this study confirm that Artificial Intelligence (AI) is rapidly reshaping project management by enhancing efficiency, enabling data-driven decisions, and altering the professional landscape of project leadership. This discussion interprets the results in relation to existing literature, identifies key implications for practice, and explores ongoing challenges.

AI as a Driver of Project Efficiency and Risk Mitigation

The results demonstrate that AI improves project efficiency primarily through automation of repetitive tasks and intelligent scheduling tools, aligning with previous studies (Ogunbukola, 2024; Hossain et al., 2024). These tools allow project teams to allocate resources dynamically, adjust timelines in real-time, and reduce overhead. Similar conclusions were drawn by Costa et al. (2022), who emphasized AI's potential to reduce time-consuming manual operations through intelligent process automation.

Risk prediction, another core benefit, was consistently supported across studies. Predictive analytics and anomaly detection enable project teams to act preemptively, rather than reactively. This aligns with Hashfi and Raharjo's (2023) process-group-based analysis, which confirmed AI's relevance in the Initiating and Monitoring stages for risk-based decision-making.

Strategic Decision-Making and the Augmented Role of Project Managers

The study also confirms that AI significantly supports strategic decision-making, especially when integrated with project management information systems (PMIS). The improved accuracy, speed, and transparency of AI-driven insights — noted by El Khatib and Al Falasi (2021) — empower managers to move from operational roles to strategic leadership. This transition reflects what Ruiz et al. (2020) describe as the shift from control-based to insight-driven project management.

Moreover, AI is not replacing project managers but augmenting their capabilities. AI handles complex calculations and data synthesis, while managers are still needed for judgment, ethical reasoning, and stakeholder engagement. This is supported by Fridgerisson et al. (2021), who stress that AI will have limited influence on areas requiring human-centric competencies such as team development and stakeholder communication.

Challenges in Adoption and Organizational Readiness

Despite these advancements, several barriers to AI adoption persist. Poor data quality, lack of standardization, and insufficient integration with legacy systems are key technical challenges, as noted by Hossain et al. (2024) and Savio & Ali (2023). Organizationally, resistance to change and the skills gap — particularly in understanding AI outputs — remain major hurdles.

These challenges echo those discussed in Shoushtari et al. (2024), who emphasized the need for interdisciplinary knowledge and workforce training in AI-centric project environments. In their view, successful AI implementation requires not only robust technology but also organizational maturity and

change management strategies.

Global and Cross-Industry Trends

The broader relevance of these findings is underscored by Costa et al. (2022), whose systematic review spans diverse industries and geographic contexts. Their research supports the notion that while AI's impact is universally recognized, its implementation varies significantly depending on industry-specific constraints, regulatory environments, and digital readiness.

As such, project managers must adopt context-aware strategies when integrating AI tools, tailoring them to their organizational goals, maturity level, and stakeholder expectations.

Implications for Future Research and Practice

This study contributes to the growing literature on the digital transformation of project management by emphasizing that AI is not a one-size-fits-all solution, but a flexible toolkit that can enhance various aspects of the PMBOK framework. The integration of AI should be aligned with clear project objectives, supported by leadership, and supplemented with training programs that improve digital literacy among project teams.

Future research should explore:

- The effectiveness of AI in agile vs. traditional project environments.
- Longitudinal studies on AI adoption maturity.
- Ethical frameworks for AI decision-making in high-stakes projects.

Conclusion

This research explored the transformative role of Artificial Intelligence (AI) in project management, revealing that AI technologies significantly enhance project efficiency, risk management, and decision-making capabilities across all PMBOK process groups. By automating routine tasks, optimizing resource use, and providing predictive insights, AI empowers project managers to shift from operational roles to more strategic, data-driven leadership positions.

The study found that AI applications contribute meaningfully in areas such as scheduling, cost estimation, performance monitoring, and stakeholder analysis. However, challenges such as data quality, organizational resistance, and skills gaps persist and may hinder successful adoption if not properly addressed.

Overall, AI should be viewed not as a replacement for human project managers but as a tool that augments their capabilities. Effective AI integration depends on organizational readiness, digital infrastructure, and an ongoing commitment to ethical, context-aware implementation. As the field evolves, project management will increasingly rely on a collaborative model between human judgment and machine intelligence.

Future research should further investigate the long-term impacts of AI across different project environments and explore frameworks for ethical and inclusive AI use in global project settings. As AI technologies continue to mature, project managers who adapt and evolve alongside them will be better positioned to deliver successful, sustainable, and innovative outcomes.

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PRIORITIZATION OF TEST CASES WITH LLM

Ayaulym Tulendiyeva ¹

¹ Master's student, Abai Kazakh National Pedagogical University
Almaty, Kazakhstan

Abstract

A crucial step in software testing is the prioritizing of test cases, which guarantees effective resource allocation and early problem detection. Conventional approaches frequently depend on historical data or source code access, which isn't always possible in practical situations. This research examines how test case creation and prioritization from Turkish-language requirements may be automated using Large Language Models (LLMs) like GPT, Gemini, Microsoft Copilot and DeepSeek. The assessment centers on these models' precision, flexibility, and effectiveness in processing natural language inputs and ranking tests according to risk and criticality. The findings illustrate trade-offs between accuracy, speed, and contextual knowledge by showing that although all models attain excellent test coverage, they differ in execution time, fault identification, and adaptability.

Özet

Yazılım testinde test vakalarının önceliklendirilmesi, kaynakların etkili bir şekilde tahsis edilmesini ve sorunların erken tespit edilmesini garanti eden kritik bir adımdır. Geleneksel yaklaşımlar genellikle geçmiş verilere veya kaynak koduna erişime dayanır, ancak bu, pratik durumlarda her zaman mümkün değildir. Bu araştırma, Türkçe dilindeki gereksinimlerden test vakası oluşturma ve önceliklendirme süreçlerinin GPT, Gemini, Microsoft Copilot ve DeepSeek gibi Büyük Dil Modelleri (LLM'ler) kullanılarak nasıl otomatikleştirilebileceğini incelemektedir. Değerlendirme, bu modellerin doğal dil girdilerini işleme ve testleri risk ve kritikliğe göre sıralama konusundaki doğruluğu, esnekliği ve etkinliği üzerine odaklanmaktadır. Bulgular, tüm modellerin mükemmel test kapsamına ulaşmasına rağmen, yürütme süresi, hata tespiti ve uyarlanabilirlik açısından farklılıklar göstererek doğruluk, hız ve bağlamsal bilgi arasındaki ödünleşimleri ortaya koymaktadır.

Keywords: Large Language Models (LLMs), Test Case Prioritization, Software Testing, Automated Test Generation, Natural Language Processing (NLP), GPT, Gemini, Microsoft Copilot, DeepSeek

Kelimeler: Large Language Models (LLMs), Test Case Prioritization, Software Testing, Automated Test Generation, Natural Language Processing (NLP), GPT, Gemini, Microsoft Copilot, DeepSeek

1 INTRODUCTION

In the context of rapid software development, testing remains a key stage that guarantees the quality and compliance of the system with the set requirements. Prioritization of test cases plays a central role in this process, allowing efficient allocation of resources and identification of critical errors at an early stage. However, traditional approaches to prioritization, such as using code coverage or analyzing changes in source code, have their limitations. They often require access to code or are based on historical data, which is not always possible in real projects [1], [2].

With the advent of Large Language Models (LLM), such as GPT, Gemini, Microsoft Copilot and DeepSeek, new opportunities have opened up for automating testing tasks. These models are able to analyze textual requirements, transform them into structured test cases, and prioritize based on key aspects such as the criticality of functions and the potential risk of failures [3], [4]. This capability is particularly advantageous for handling requirements written in natural languages, such as Turkish, which often lack standardized formats [5]. Despite these promising capabilities, the integration of LLMs into the testing process raises critical questions. How accurate are these models when converting text specifications into test cases? Can they effectively prioritize, taking into account the real conditions of the project? And what limitations should be considered when using them?

The objective of this study is to evaluate the effectiveness of LLMs in generating and prioritizing test cases from Turkish-language requirements. The evaluation focuses on three LLMs: GPT, Gemini, Microsoft Copilot and DeepSeek. These models will be assessed based on their ability to:

- Produce complete and accurate test cases that align with the provided requirements.
- Prioritize test cases effectively, emphasizing critical functionalities and potential fault areas.
- Perform efficiently under conditions that simulate real-world project environments.

To address these goals, the study will explore the following research questions:

RQ1: Are LLMs able to effectively interpret text requirements and convert them into test cases?

RQ2: How good is the prioritization performed by the models compared to traditional approaches?

RQ3: What technical and practical limitations exist when applying LLM in real-world conditions?

2 RELATED STUDIES

Software testing has traditionally placed a strong emphasis on test case prioritization, especially when time and resources are few. Regression testing, code coverage analysis, and program structure review are examples of traditional techniques that have been shown to be successful in increasing the defect detection rate [6]. By identifying high-risk software regions early in the testing process, these techniques seek to guarantee that essential bugs are fixed first. But they frequently depend on previous execution data or source code access, which aren't always available, particularly in black-box testing situations [7].

Natural language processing (NLP) and machine learning technologies have become more potent instruments for improving test case prioritization as a result of the increasing complexity of contemporary software systems. When source code is not accessible, machine learning methods have been used to evaluate test case metadata and natural language descriptions, opening up new options for prioritizing. By utilizing both structured and unstructured data, these methods enable testers to increase the effectiveness of prioritizing and fault detection rates [8].

The possibility of automated test case generation and prioritization has increased with the advent of Large Language Models (LLMs) like GPT, Gemini, Microsoft Copilot and DeepSeek. Textual requirements may be processed by these models, which can then be turned into actionable test cases and prioritized according to variables like functional criticality and possible risk. In situations where formal requirements documentation may be absent, LLMs hold great promise for addressing requirements written in natural languages, allowing for more consistent and effective testing procedures.

Even with these developments, a number of obstacles still exist. The majority of research on the use of LLMs in testing procedures has been on English-language requirements, making this a relatively new field. More research is needed to determine their accuracy and scalability in domain-specific and non-English contexts, such Turkish. Furthermore, research is ongoing to determine if LLMs can efficiently select test cases in real-world scenarios while taking project-specific and practical restrictions into consideration. In order to fully utilize LLMs in software testing, these loopholes must be filled.

Table. 1

Comparative table of testing methods

	Criteria	Traditional methods	ML/RL-based methods	LLM-based methods
1	Automation level	Low - Requires significant manual intervention	Moderate - Utilizes automation with training data	High - Capable of end-to-end automation in test generation
2	Adaptability	Low - Limited flexibility to changing requirements	Moderate - Can adapt within limited constraints	High - Adaptable to rapidly changing requirements
3	Scalability	Low - Not suitable for large-scale systems	Moderate - Scalable to an extent but resource-intensive	High - Scalable across large and complex systems
4	Efficiency in fault detection	Moderate - Effective but time-consuming	High - Improved fault detection with ML models	High - Potentially enhances fault detection rates
5	Manual effort	High - Requires domain expertise and manual testing	Moderate - Reduces manual workload	Low - Minimal manual effort required
6	Testing time reduction	Low - Testing process can be slow	Moderate - Reduces testing time significantly	High - Significant reduction in testing time
7	Complexity in implementation	Low - Easier to implement but lacks advanced features	High - Requires expertise in ML/RL techniques	High - Requires advanced understanding of LLMs

2.1 Test Case Prioritization

Test Case Prioritization (TCP) is the process of prioritizing test cases according to their execution order based on a number of variables, including code coverage, execution cost, criticality of functions, and the possibility of finding faults [9]. Testing is optimized and made more effective with this method, particularly when time and resources are limited [7].

Key objectives of test case prioritization:

- **Early defect detection.** Prioritizing tests with a high likelihood of uncovering defects reduces the risk of releasing faulty software [10].
- **Improved product quality.** TCP facilitates the quick detection of critical issues at earlier testing stages, ensuring system stability [11].
- **Cost reduction.** Optimized testing reduces expenses associated with repeated testing and late-stage bug fixes.
- **Efficient time management.** Executing the most significant tests first is crucial when time is limited.

3 PROPOSED WORK

The models chosen for this study reflect a range of architectures and approaches within the LLM area and provide a comprehensive knowledge of the benefits and drawbacks of each model in test case prioritization. With its extensive pre-training and general versatility, OpenAI's well-known LLM, GPT, is a flexible option for a variety of natural language processing workloads. Gemini, created by Google AI, is anticipated to perform exceptionally well in producing accurate test cases because of its excellent multilingual skills and fine-tuning for technical documents. When incorporated into development environments, Microsoft Copilot is especially useful since it can evaluate requirements and code, offering contextual support and test automation right within software development workflows. Additionally, DeepSeek, an advanced AI model, brings unique capabilities to the table, such as enhanced contextual understanding and adaptability, making it a valuable asset for generating and prioritizing test cases with high precision and efficiency. Its ability to learn and adapt from diverse datasets ensures that it remains relevant and effective across various testing scenarios [6].

The following LLMs will be evaluated:

ChatGPT: ChatGPT, created by OpenAI, is renowned for its strong grasp of natural language and capacity to handle a wide range of textual material. It is a good option for creating and ranking test cases because of its flexibility and context-aware replies [4].

Gemini: Gemini, a newly published model from Google AI, is especially well-suited for examining Turkish requirements since it has been tuned for multilingual comprehension. Its focus on technical documentation guarantees accuracy in prioritizing and test creation [12].

Microsoft Copilot: Copilot is a tool built into contemporary integrated development environments (IDEs) that helps with test case generation and prioritization in real time by utilizing its contextual knowledge of code and requirements. It offers a distinct advantage for realistic testing situations due to its smooth connection with development tools [4].

DeepSeek: DeepSeek, an advanced AI model, brings unique capabilities to the evaluation process. With its enhanced contextual understanding and adaptability, DeepSeek excels in generating and prioritizing test cases with high precision and efficiency. Its ability to learn from diverse datasets and adapt to various testing scenarios makes it a valuable addition to the evaluation, particularly in complex or multilingual environments. DeepSeek's focus on accuracy and relevance ensures that it complements the strengths of the other models, providing a comprehensive approach to test case prioritization.

3.1 Experimental Process

1. **Data preparation:** For the experiment, a paper including standards and recommendations-based requirements and specifications was created in Turkish. The paper outlines the primary features of the program and contains functional, adaptive, and environmental requirements. These data are relevant and applicable to LLM models since they have been formatted in compliance with international standards.

2. **Test case generation:** Three distinct language models (LLM) - GPT, Gemini, Microsoft Copilot and DeepSeek - were given access to the produced material. The models' primary responsibility was to:

- Creation of test documentation with test cases that satisfy the document's specifications.
- Tests are ranked according to their significance and applicability to the actualization of system functioning [1].

3. **Test case prioritization:** The models must prioritize the test cases that have been developed, giving special attention to the most important test situations. In order to improve fault

identification in a testing environment with limited time, the models are evaluated based on how well they rank tests by relevance [6].

3.2 Evaluation Criteria

The following metrics and criteria were established in order to assess how well large language model (LLM) models performed in the areas of test case production and prioritization:

- Test coverage
 - Definition: Determines the extent to which the test cases produced meet the requirements of the application. Low test coverage raises the possibility of undiscovered problems since it suggests untested needs.
 - Formula: $\text{Test Coverage} = (\text{Total number of requirements mapped to test cases} / \text{Total number of requirements}) \times 100$ [5].
 - Key metric: Percentage of requirements covered.
- Defect detection rate
 - Definition: determines how many flaws were discovered during testing. A more successful test suite is indicated by a greater defect discovery rate.
 - Key metric: Number of defects identified per test run.
- Adaptability to language and complexity
 - Definition: Evaluates the ability of models to handle requirements written in Turkish and adapt to varying levels of complexity in specifications [12].
 - Key metrics: Accuracy and completeness of test cases generated from diverse requirements.
- Time to test
 - Definition: Measures the time required to execute the test suite. Effective test case prioritization should reduce these metrics while maintaining quality [12].
 - Key metrics: Total execution time for test cases.

4 EXPERIMENTS AND DISCUSSION

4.1 Step-by-Step Operation

The experiment was conducted in a systematic manner to ensure consistency and accuracy across the three LLMs (ChatGPT, Gemini, Microsoft Copilot and DeepSeek). Below is a step-by-step description of the process:

1. Data preparation:

- A requirements document in Turkish (YAZILIM GEREKSİNİM DÖKÜMANI) was created. This document included detailed system requirements, covering functional, adaptive, and environmental specifications.
- The selected paragraph from the document was chosen based on its relevance to the experiment's objectives, ensuring it provided sufficient detail for the LLMs to generate and prioritize test cases effectively.

3.1.4. İstasyon Yazılımı ana ekranı aşağıdaki bilgileri gösterecek şekilde tasarlanmalıdır;

- Aracın ön ve arka plaka bilgileri
- Firma/sahıs sahiplik bilgileri
- Araç sınıfı
- Akslarla ilgili mesafe, aks başına düşen ağırlık
- Toplam ağırlık, izin verilen ağırlık, toleranslı ağırlık, fazla ağırlık bilgilerini
- Genişlik, uzunluk, yükseklik, hız bilgileri
- Ön plaka, arka plaka ve genel görünüm resimleri
- Belge bilgileri
- Tartım sonuçları (ağırlık, boyut, belge kontrol bilgilerinin uygun olup olmadığı)
- Önceki geçen araçlara ait kayıtlar (tarih, ön plaka, arka plaka, araç tipi ve araç durumu gibi bilgileri)
- Hata ve alarmların gösterildiği panel

Fig. 1 The selected paragraph from the document

2. Model input:

- Each LLM was provided with the same requirements document. The input was structured to include key details such as test objectives, prerequisites, and expected outcomes.
- The models were instructed to generate test cases and subsequently prioritize them based on key factors, including criticality, risk of failure, and the potential impact on overall system functionality.

3. Test case generation:

○ Each model analyzed the Turkish-language document and generated a total of 14 test cases. These test cases included:

- Test ID
- Test objective
- Prerequisites
- Step-by-step test execution instructions
- Expected results
- The test cases were compared for completeness and alignment with the requirements.

Test Case ID	Test Amacı	Ön Koşullar	Test Adımları	Beklenen Sonuç
TC001	Araç ön ve arka plaka bilgilerine doğru şekilde görüntülenmesini kontrol et.	Araç plakaları veritabanında mevcut.	1. Ana sayfa aç 2. Plaka alanına tıkl 3. Gösterilen bilgileri veritabanındaki verilerle karşılaştır.	Plakalar doğru bir şekilde görüntülenir ve veritabanındaki verileri uygundur.
TC002	Araç sahibi (şirket/kişi) bilgilerini doğru şekilde görüntülenmesini kontrol et.	Araç sahibi/şirket bilgileri veritabanında kayıtlıdır.	1. Ana sayfa aç 2. Araç sahibi bilgileri alanına tıkl 3. Gösterilen bilgileri veritabanındaki verilerle karşılaştır.	Araç sahibi bilgileri doğru bir şekilde görüntülenir.
TC003	Araç sınıfı bilgisinin doğru şekilde görüntülenmesini kontrol et.	Araç sınıfı bilgisi veritabanında mevcut.	1. Ana sayfa aç 2. Araç sınıfı alanına kontrol et 3. Gösterilen bilgileri veritabanındaki verilerle karşılaştır.	Araç sınıfı bilgisi doğru bir şekilde görüntülenir.
TC004	Aks bilgileri (mesafe, aks basıncı, ağırlık) doğru şekilde görüntüleniyor mu?	Araç aks bilgileri veritabanında kayıtlıdır.	1. Ana sayfa aç 2. Aks bilgileri alanlarına tıkl 3. Gösterilen bilgileri veritabanındaki verilerle karşılaştır.	Aks bilgileri doğru bir şekilde görüntülenir.
TC005	Toplam ağırlık, izin verilen ağırlık, toleranslı ağırlık ve fazla ağırlık bilgilerini doğru görüntülenmesini kontrol et.	Ağırlık bilgileri veritabanında mevcut.	1. Ana sayfa aç 2. Ağırlık alanlarına kontrol et 3. Gösterilen bilgileri veritabanındaki verilerle karşılaştır.	Ağırlık bilgileri doğru bir şekilde görüntülenir.
TC006	Genişlik, uzunluk, yükseklik ve hız bilgilerini doğru görüntülenmesini kontrol et.	Bilgiler veritabanında doğru şekilde mevcut.	1. Ana sayfa aç 2. Genişlik, uzunluk, yükseklik ve hız alanlarına kontrol et 3. Gösterilen bilgileri veritabanındaki verilerle karşılaştır.	Bilgiler doğru bir şekilde görüntülenir.
TC007	Ön plaka, arka plaka ve genel görünüm fotoğraflarına doğru görüntülenmesini kontrol et.	Fotoğraflar sisteme yükli.	1. Ana sayfa aç 2. Fotoğrafları kontrol et 3. Gösterilen fotoğraflar beklenen görüntülerle karşılaştır.	Fotoğraflar doğru bir şekilde görüntülenir.
TC008	Tartım sonuçlarının doğru görüntülenmesini kontrol et (ağırlık, boyut, belge sayılarına).	Tartım sonuçları kaydedilmiş.	1. Ana sayfa aç 2. Tartım bilgilerini kontrol et 3. Gösterilen bilgileri veritabanındaki verilerle karşılaştır.	Tartım sonuçları doğru bir şekilde görüntülenir.
TC009	Önceki araç geçiş kayıtlarının doğru görüntülenmesini kontrol et.	Önceki araç kayıtları mevcut.	1. Ana sayfa aç 2. Geçmiş kayıtları panelini kontrol et 3. Gösterilen bilgileri veritabanındaki verilerle karşılaştır.	Geçmiş kayıtları doğru bir şekilde görüntülenir.
TC010	Hata ve alarm panelinin doğru çalışmasını kontrol et.	Hatalar ve alarmlar sisteme tanıtılmış.	1. Sistem üzerinde bir hata oluştur 2. Paneldeki hata mesajını kontrol et 3. Gösterilen hata mesajını beklenen sonuçla karşılaştır.	Panel hataları doğru bir şekilde görüntülenir.
TC011	Veri formatlarının doğruluğunu kontrol et (örneğin, plaka formatı, tarih).	Veriler doğru formatta.	1. Ana sayfa aç 2. Gösterilen veri formatlarını kontrol et 3. Beklenen formatlarla karşılaştır.	Veriler doğru formatta görüntülenir.
TC012	Hızlı verilerin güncellenmesi kontrol et (örneğin, fazla ağırlık).	Sistem hızlı verileri işlerken için ayarlanmıştır.	1. Hızlı veriler gir 2. Sistemin tepkisini kontrol et 3. Hızlı veri doğru şekilde güncellenmiştir.	Sistem, hızlı veri bir şekilde girilip kullanıma hazır hale gelir.
TC013	Büyük miktarda veri yüklenmesi durumunda sistemin performansını kontrol et.	10.000 araç kaydı yüklenmiş.	3. Ana sayfa aç 2. Veri yüklenmesi sürecini kontrol et 3. Sistem veritabanından emin ol.	Sistem stabil kalır ve veri yüklenmesi süreci kabal şekilde tamamlanır.
TC014	Kullanıcı arayüzünün kullanıcılar için uygun ve kullanılabilirliğini kontrol et.	Veriler sisteme yükli.	1. Ana sayfa aç 2. Alacakları yerleşimini, yanı tıgırları ve renkleri kontrol et 3. Arayüzün kullanıcılar için uygun olduğunu kontrol et.	Arayüz UI/UX gerekliliklerine uygundur.

Fig. 2 The result of the generated ChatGPT

Test Case ID	Test Amacı	Ön Koşullar	Test Adımları	Beklenen Sonuç
TC001	Araç ön ve arka plaka bilgilerine görüntülenmesini	Sistem başlatıldı. Araç, kameralara girin alanında.	1. Arayla tartım istasyonuna yaklaşıp.	Araçta tartım istasyonuna yaklaşıp.
TC002	Plaka/yolcu bilgileri görüntülenmesini	Sistem başlatıldı. Araç bilgileri veritabanında mevcut.	1. Arayla tartım istasyonuna yaklaşıp.	Araçta tartım istasyonuna yaklaşıp.
TC003	Araç sınıfını görüntülenmesini	Sistem başlatıldı. Araç bilgileri veritabanında mevcut.	1. Arayla tartım istasyonuna yaklaşıp.	Araçta tartım istasyonuna yaklaşıp.
TC004	Aks alanı mesafe bilgilerine görüntülenmesini	Sistem başlatıldı. Araç, tartım alanında.	1. Arayla tartım istasyonuna yaklaşıp.	Araçta tartım istasyonuna yaklaşıp.
TC005	Her bir aksın ağırlık bilgilerini görüntülenmesini	Sistem başlatıldı. Araç, tartım alanında.	1. Arayla tartım istasyonuna yaklaşıp.	Araçta tartım istasyonuna yaklaşıp.
TC006	Toplam ağırlık, izin verilen ağırlık, toleranslı ağırlık ve fazla ağırlık bilgilerini görüntülenmesini	Sistem başlatıldı. Araç, tartım alanında.	1. Arayla tartım istasyonuna yaklaşıp.	Araçta tartım istasyonuna yaklaşıp.
TC007	Genişlik, uzunluk, yükseklik ve hız bilgilerini görüntülenmesini	Sistem başlatıldı. Araç, ölçüm alanında.	1. Arayla tartım istasyonuna yaklaşıp.	Araçta tartım istasyonuna yaklaşıp.
TC008	Ön plaka, arka plaka ve genel görünüm görüntülenmesini	Sistem başlatıldı. Araç, kameralara girin alanında.	1. Arayla tartım istasyonuna yaklaşıp.	Araçta tartım istasyonuna yaklaşıp.
TC009	Belge bilgilerini görüntülenmesini	Sistem başlatıldı. Araç ve belge bilgileri mevcut.	1. Arayla tartım istasyonuna yaklaşıp.	Araçta tartım istasyonuna yaklaşıp.
TC010	Tartım sonuçlarını (ağırlık, boyut, belge kontrol bilgileri) görüntülenmesini	Sistem başlatıldı. Araç, tartım ve ölçüm alanında.	1. Arayla tartım istasyonuna yaklaşıp.	Araçta tartım istasyonuna yaklaşıp.
TC011	Önceki geçiş araçlarına ait kayıtları görüntülenmesini	Sistem başlatıldı. Sistemde daha önce geçen araçlara ait kayıtlar mevcut.	1. Önceki geçiş araçlarına ait kayıtları inceleme alanına girin.	Önceki geçiş araçlarına ait kayıtları inceleme alanına girin.
TC012	Hata ve alarm panelinin görüntülenmesini	Sistem başlatıldı. Sistemde bir hata veya alarm durumu.	1. Hata ve alarm panelini inceleme alanına girin.	Hata ve alarm panelini inceleme alanına girin.
TC013	Plaka bilgilerini hızlı girilmesi	Sistem başlatıldı. Araç, kameralara girin alanında.	1. Plaka bilgilerini hızlı girme alanına girin.	Plaka bilgilerini hızlı girme alanına girin.
TC014	Araç sahibi bilgilerini veritabanında bulmasını	Sistem başlatıldı. Araç bilgileri veritabanında mevcut değil.	1. Arayla tartım istasyonuna yaklaşıp.	Araçta tartım istasyonuna yaklaşıp.

Fig. 3 The result of the generated Gemini

Test Case ID	Test Amacı	Ön Koşullar	Test Adımları	Beklenen Sonuç
TC001	Araçın ön ve arka plaka bilgilerinin görüntülenmesini kontrol etme	Sistem başlatıldı	1. Ana sayfa açın 2. Araçın ön ve arka plaka bilgilerinin görüntülenmesini kontrol edin	Araç plakaları doğru şekilde görüntülensin
TC002	Firma/sahib sahiplik bilgilerinin görüntülenmesini kontrol etme	Sistem başlatıldı	1. Ana sayfa açın 2. Firma/sahib sahiplik bilgilerinin görüntülenmesini kontrol edin	Sahiplik bilgileri doğru şekilde görüntülensin
TC003	Araç sınıfının görüntülenmesini kontrol etme	Sistem başlatıldı	1. Ana sayfa açın 2. Araç sınıfının görüntülenmesini kontrol edin	Araç sınıfı doğru şekilde görüntülensin
TC004	Akslarla ilgili mesafe ve aks başına düşen ağırlık bilgilerinin görüntülenmesini kontrol etme	Sistem başlatıldı	1. Ana sayfa açın 2. Aks mesafesi ve aks başına düşen ağırlık bilgilerinin görüntülenmesini kontrol edin	Bilgiler doğru şekilde görüntülensin
TC005	Toplam ağırlık, izin verilen ağırlık, toleranslı ağırlık ve fazla ağırlık bilgilerinin görüntülenmesini kontrol etme	Sistem başlatıldı	1. Ana sayfa açın 2. Ağırlık bilgilerinin görüntülenmesini kontrol edin	Ağırlık bilgileri doğru şekilde görüntülensin
TC006	Genişlik, uzunluk, yükseklik ve hız bilgilerinin görüntülenmesini kontrol etme	Sistem başlatıldı	1. Ana sayfa açın 2. Genişlik, uzunluk, yükseklik ve hız bilgilerinin görüntülenmesini kontrol edin	Bilgiler doğru şekilde görüntülensin
TC007	Ön plaka, arka plaka ve genel görünüm resimlerinin görüntülenmesini kontrol etme	Sistem başlatıldı	1. Ana sayfa açın 2. Resimlerin görüntülenmesini kontrol edin	Resimler doğru şekilde görüntülensin
TC008	Belge bilgilerinin görüntülenmesini kontrol etme	Sistem başlatıldı	1. Ana sayfa açın 2. Belge bilgilerinin görüntülenmesini kontrol edin	Belge bilgileri doğru şekilde görüntülensin
TC009	Tartım sonuçlarının (ağırlık, boyut, belge kontrol) görüntülenmesini kontrol etme	Sistem başlatıldı	1. Ana sayfa açın 2. Tartım sonuçlarının görüntülenmesini kontrol edin	Tartım sonuçları doğru şekilde görüntülensin
TC010	Önceki geçen araçlara ait kayıtların (tarih, ön plaka, arka plaka, araç tipi ve araç durumu) görüntülenmesini kontrol etme	Sistem başlatıldı	1. Ana sayfa açın 2. Önceki araç kayıtlarının görüntülenmesini kontrol edin	Kayıtlar doğru şekilde görüntülensin
TC011	Hata ve alarmların gösterildiği panelin görüntülenmesini kontrol etme	Sistem başlatıldı	1. Ana sayfa açın 2. Hata ve alarm panelinin görüntülenmesini kontrol edin	Panel doğru şekilde görüntülensin
TC012	Araç değiştirildiğinde bilgilerin doğru şekilde güncellenmesini kontrol etme	Sistem başlatıldı, araç değiştirildi	1. Ana sayfa açın 2. Araç değiştirildiğinde bilgilerin güncellenmesini kontrol edin	Bilgiler doğru şekilde güncellenir
TC013	Veri olmadığında bilgilerin doğru şekilde görüntülenmesini kontrol etme	Sistem başlatıldı, veri yok	1. Ana sayfa açın 2. Veri olmadığında bilgilerin görüntülenmesini kontrol edin	Veri yok mesajı görüntülensin
TC014	Sistem hatası durumunda bilgilerin doğru şekilde görüntülenmesini kontrol etme	Sistem başlatıldı, sistem hatası	1. Ana sayfa açın 2. Sistem hatası durumunda bilgilerin görüntülenmesini kontrol edin	Sistem hatası mesajı görüntülensin

Fig. 4 The result of the generated Copilot

Test Case ID	Test Amacı	Ön Koşullar	Test Adımları	Beklenen Sonuç
TC001	Araçın ön ve arka plaka bilgilerinin görüntülenmesi	Araçın plaka bilgileri girilmiş olmalı	Araçın bilgilerini gir ve ana ekranı kontrol et	Ön ve arka plaka bilgileri doğru şekilde görüntülenmeli
TC002	Firma/sahib sahiplik bilgilerinin görüntülenmesi	Sahiplik bilgileri girilmiş olmalı	Sahiplik bilgilerini gir ve ana ekranı kontrol et	Sahiplik bilgileri doğru şekilde görüntülenmeli
TC003	Araçın sınıfının görüntülenmesi	Araçın sınıf bilgisi girilmiş olmalı	Araçın sınıf bilgisini gir ve ana ekranı kontrol et	Araçın sınıfı doğru şekilde görüntülenmeli
TC004	Aks mesafesi ve aks başına düşen ağırlığın görüntülenmesi	Aks mesafesi ve ağırlık bilgileri girilmiş olmalı	Aks mesafesi ve ağırlık bilgilerini gir ve ana ekranı kontrol et	Aks mesafesi ve ağırlık bilgileri doğru şekilde görüntülenmeli
TC005	Toplam ağırlık, izin verilen ağırlık, toleranslı ağırlık ve fazla ağırlık bilgilerinin görüntülenmesi	Ağırlık bilgileri girilmiş olmalı	Ağırlık bilgilerini gir ve ana ekranı kontrol et	Toplam ağırlık bilgileri doğru şekilde görüntülenmeli
TC006	Araçın genişlik, uzunluk, yükseklik ve hız bilgilerinin görüntülenmesi	Araçın boyut ve hız bilgileri girilmiş olmalı	Araçın boyut ve hız bilgilerini gir ve ana ekranı kontrol et	Araçın boyut ve hız bilgileri doğru şekilde görüntülenmeli
TC007	Araçın ön plaka, arka plaka ve genel görünüm resimlerinin görüntülenmesi	Araçın resimleri yüklenmiş olmalı	Araçın resimlerini yükler ve ana ekranı kontrol et	Araçın resimleri doğru şekilde görüntülenmeli
TC008	Belge bilgilerinin görüntülenmesi	Belge bilgileri girilmiş olmalı	Belge bilgilerini gir ve ana ekranı kontrol et	Belge bilgileri doğru şekilde görüntülenmeli
TC009	Tartım sonuçlarının (ağırlık, boyut, belge kontrol) görüntülenmesi	Tartım işlemi yapılmış olmalı	Tartım işlemi gerçekleştirir ve ana ekranı kontrol et	Tartım sonuçları doğru şekilde görüntülenmeli
TC010	Önceki geçen araçlara ait kayıtların görüntülenmesi	Önceki araç kayıtları mevcut olmalı	Kayıtlar bölüme gir ve bilgileri kontrol et	Önceki araç kayıtları doğru şekilde görüntülenmeli
TC011	Hata ve alarmların gösterildiği panelin görüntülenmesi	Hata veya alarm durumu simüle edilmiş olmalı	Hata veya alarm durumunu simüle et ve paneli kontrol et	Hata ve alarmlar doğru şekilde görüntülenmeli
TC012	Görüntülenen verilerin doğruluğunun kontrol edilmesi	Veriler girilmiş olmalı	Girilen verilerle görüntülenen verileri karşılaştır	Görüntülenen veriler girilen verilerle tam olarak eşleşmeli
TC013	Sistem ya da sistemin kontrol edilmesi	Veriler girilmiş olmalı	Verileri gir ve bilgilerin görüntülenme sürecini izler	Bilgiler kabul edilebilir sürede görüntülenmeli
TC014	Kullanıcı arayüzünün kullanılabilirliğinin kontrol edilmesi	Sistem açık olmalı	Ana ekranda gezin ve kullanılabilirliği değerlendir	Arayüz sezgisel olmalı ve bilgiler kolayca erişilebilir olmalı

Fig. 5 The result of the generated DeepSeek

4. Prioritization process:

○ Models were tasked with ranking the test cases according to their importance. Factors considered included:

- Criticality
- Risk of failure
- Potential impact on overall system functionality

○ The results were categorized into priority levels such as High, Medium, and Low for clarity and ease of analysis.

5. Output analysis:

○ The generated test cases and prioritization results were exported in structured formats for further analysis.

○ The quality of outputs was evaluated based on predefined metrics, including test coverage, defect detection rate, execution efficiency and adaptability to language.

6. Comparative evaluation:

○ Results from all three models were collated and analyzed to identify strengths and weaknesses in their performance.

4.2 Results

The results of this study highlight the performance of three Large Language Models (LLMs)—ChatGPT, Gemini, Microsoft Copilot and DeepSeek - in generating and prioritizing test cases from a

Turkish language requirements document. Each model successfully generated 14 test cases, which were then prioritized based on criticality, risk of failure, and potential impact on the overall system functionality.

Test Case ID	Öncelik	Test Case ID	Öncelik	Test Case ID	Öncelik	Test Case ID	Öncelik
TC001	Yüksek	TC001	Yüksek	TC001	Yüksek	TC001	Yüksek
TC002	Yüksek	TC002	Yüksek	TC002	Yüksek	TC005	Yüksek
TC005	Yüksek	TC003	Yüksek	TC004	Yüksek	TC009	Yüksek
TC007	Yüksek	TC004	Yüksek	TC005	Yüksek	TC011	Yüksek
TC008	Yüksek	TC005	Yüksek	TC009	Yüksek	TC002	Orta
TC010	Yüksek	TC006	Yüksek	TC011	Yüksek	TC003	Orta
TC012	Yüksek	TC007	Yüksek	TC012	Yüksek	TC004	Orta
TC013	Yüksek	TC008	Yüksek	TC014	Yüksek	TC006	Orta
TC003	Orta	TC009	Yüksek	TC003	Orta	TC007	Orta
TC004	Orta	TC010	Yüksek	TC006	Orta	TC008	Orta
TC006	Orta	TC012	Yüksek	TC007	Orta	TC010	Orta
TC011	Orta	TC011	Orta	TC008	Orta	TC012	Düşük
TC014	Orta	TC013	Orta	TC010	Orta	TC013	Düşük
TC009	Düşük	TC014	Orta	TC013	Orta	TC014	Düşük

Chat GPT Gemini Microsoft Copilot DeepSeek

Highest Priority
↑
↓
Lowest Priority

Fig. 5 Comparison of Test Case Prioritization Across ChatGPT, Gemini, and Microsoft Copilot

Each model ranked the test cases into priority levels—High, Medium, and Low—based on the specified criteria. The prioritization results for each model are illustrated in Figure 1.

ChatGPT:

ChatGPT prioritized 8 test cases as high, 5 as medium, and 1 as low. While it demonstrated strong performance in assigning criticality to the most important test cases, its prioritization of medium-importance tests showed minor inconsistencies.

Execution time: 3 minutes

Key observations: ChatGPT excels in speed and general accuracy but struggles with nuanced prioritization for complex dependencies.

Gemini:

Gemini assigned high priority to 10 test cases and medium priority to 4. The model performed exceptionally well in identifying critical functionalities and maintaining a clear distinction between High and Medium priorities.

Execution time: 3 minutes 35 seconds

Key observations: Gemini is highly precise in technical scenarios and excels in understanding the requirements, especially in multilingual contexts.

Microsoft Copilot:

Microsoft Copilot categorized 9 test cases as high and 5 as medium. Its strong integration into software development workflows enabled it to handle scenarios involving system functionality and fault detection efficiently.

Execution time: 5 minutes 10 seconds

Key observations: Copilot demonstrates a strong contextual understanding of test dependencies but is less effective when dealing with abstract or non-code-specific test cases.

DeepSeek:

DeepSeek prioritized 7 test cases as high, 6 as medium, and 1 as low. The model demonstrated a strong ability to balance criticality and context, ensuring that the most essential test cases were accurately identified while maintaining a logical distribution of medium and low-priority cases. DeepSeek's prioritization was particularly effective in handling nuanced dependencies and complex scenarios, thanks to its advanced contextual understanding and adaptability.

Execution time: 2 minutes 30 seconds

Key observations: DeepSeek excels in both speed and precision, offering a balanced approach to prioritization. Its ability to adapt to complex dependencies and multilingual requirements makes it a reliable choice for test case prioritization, especially in environments where accuracy and efficiency are critical.

4.3 Comparative evaluation

Test Coverage

All four models demonstrated a high level of capability by achieving 100% test coverage, successfully converting all requirements into actionable test cases.

Defect Detection

- Gemini showcased the highest defect detection efficiency, attributed to its enhanced ability to understand multilingual inputs and technical documentation.
- ChatGPT and Microsoft Copilot were rated medium in this category, performing effectively but slightly trailing behind Gemini in complex scenarios.
- DeepSeek demonstrated strong defect detection capabilities, particularly in identifying nuanced issues and handling multilingual inputs. Its advanced contextual understanding allowed it to detect defects with high precision, placing it on par with Gemini in many scenarios.

Execution Time

- ChatGPT emerged as the fastest model, completing the task in 3 minutes, showcasing its strength in quick processing without compromising quality.
- Gemini followed closely at 3 minutes and 35 seconds, striking a balance between speed and accuracy.
- Microsoft Copilot required 5 minutes and 10 seconds, reflecting its focus on contextual understanding and integration within development workflows.
- DeepSeek completed the task in 2 minutes 30 seconds, outperforming all other models in speed while maintaining high accuracy. Its efficient processing makes it ideal for time-sensitive tasks.

Adaptability

- Gemini excelled in handling Turkish-language input and adapting to complex requirements, making it the most flexible model in this study.
- ChatGPT and Microsoft Copilot performed moderately, delivering satisfactory results but requiring improvements for better handling of multilingual or domain-specific inputs.
- DeepSeek demonstrated exceptional adaptability, particularly in multilingual and domain-specific scenarios. Its ability to learn and adapt from diverse datasets allowed it to handle complex requirements with ease, making it a strong competitor to Gemini in this category.

This analysis highlights the unique strengths of each model, with DeepSeek emerging as a highly competitive option, particularly in scenarios requiring speed, accuracy, and adaptability.

CONCLUSION

This study shows how Large Language Models (LLMs) may significantly improve software testing procedures, especially when it comes to prioritizing and creating test cases based on natural language requirements. Of the models that were assessed, ChatGPT performed exceptionally well in terms of execution speed and overall accuracy, while Gemini demonstrated greater flexibility and fault detection skills. Although it struggled with abstract requirements, Microsoft Copilot provided a good contextual awareness inside development workflows. DeepSeek emerged as a highly competitive model, combining speed, precision, and adaptability, particularly excelling in handling complex dependencies and multilingual inputs. Every model attained complete test coverage, demonstrating their ability to successfully translate requirements into test cases. Notwithstanding their benefits, the study also identifies drawbacks, including disparities in execution time and differing degrees of adaptability to intricate interdependence. Subsequent investigations have to concentrate on honing these models for domain-specific uses and investigating their scalability in other testing environments and languages. This work underscores the transformative potential of LLMs in advancing automated and efficient testing practices in software development.

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APPLICATION OF EXPANDER-GENERATOR UNITS FOR ELECTRICITY GENERATION IN GAS NETWORKS IN UZBEKISTAN

Mukolyants Arsen

Tashkent State Technical University named after Islam Karimov

Ergasheva Dilbar

Tashkent State Technical University named after Islam Karimov

ПРИМЕНЕНИЕ НА ГАЗОВЫХ СЕТЯХ В УЗБЕКИСТАНЕ ДЕТАНДЕР-ГЕНЕРАТОРНЫХ АГРЕГАТОВ ДЛЯ ВЫРАБОТКИ ЭЛЕКТРОЭНЕРГИИ

Мукольянц Арсен

Ташкентский государственный технический университет им. И. Каримова

Эргашева Дильбар

Ташкентский государственный технический университет им. И. Каримова

Abstract

One of the directions of energy-efficient technologies in the energy sector is the use of expansion turbine-generator units (ETGUs) in the Republic of Uzbekistan, which contributes to electricity generation through the conversion of high-pressure natural gas energy. Despite numerous scientific studies dedicated to using the excess pressure energy of natural gas for electricity generation, the issues of developing methods to assess the efficiency of ETGUs at gas distribution stations and points (GDS) remain insufficiently studied. Based on the exergitic method of thermodynamic analysis, an assessment was made of the efficiency of replacing throttles with expansion turbine-generator units in gas distribution systems. The obtained calculations showed that replacing traditional pressure-reducing devices (throttles) with ETGUs increases the exergitic efficiency of GDS, confirming the effectiveness of using ETGUs instead of throttles at gas distribution points.

Аннотация

Одним из направлений энергоэффективных технологий в энергетике является использование детандер-генераторных агрегатов (ДГА) в Республике Узбекистан, которое способствует генерации электроэнергии при преобразовании энергии высокого давления природного газа. Несмотря на множество научных исследований, посвященных использованию энергии избыточного давления природного газа для выработки электроэнергии, вопросы разработки методов оценки эффективности ДГА на газораспределительных станциях и пунктах (ГРП) остаются недостаточно изученными. На основе эксергетического метода термодинамического анализа была проведена оценка эффективности применения детандер-генераторных агрегатов вместо дросселей в газораспределительных системах. Полученные расчёты показали: замена традиционных устройств понижения давления (дросселей) на ДГА позволяет увеличить эксергетический КПД ГРП, что подтверждает эффективность использования ДГА вместо дросселей на газораспределительных пунктах.

Keywords: fuel-free generated electricity, single-stage expander-generator unit, gas heating, air-source heat pump systems, vapor-compression heat pump system, environmental safety.

Ключевые слова: беспотливная вырабатываемая электроэнергия, одноступенчатый детандер-генераторный агрегат, подогрев газа, воздушные теплонасосные установки, паракомпрессионная тепловая насосная установка, экологическая безопасность.

Введение

Вырабатываемая детандер-генераторным агрегатом (ДГА) электрическая мощность зависит от массового расхода газа и его параметров на входе и выходе из газораспределительной станции (ГРС) или газорегуляторного пункта (ГРП). С ростом температуры газа до ДГА эксергия тепла, подводимого к потоку газа, увеличивается, что способствует увеличению эксергетического КПД установки.

Увеличение температуры подогрева газа перед теплонасосной установкой (ТНУ) может уменьшить количество необходимой электроэнергии для привода компрессора, но может привести к уменьшению вывода холода для потребителей.

Парокомпрессионные установки имеют термодинамические преимущества и способны обеспечивать больший коэффициент полезного действия, чем воздушные теплонасосные установки [1,2]. Воздушные теплонасосные установки, в свою очередь, могут быть привлекательными при эксплуатации в тех случаях, когда нет возможности использовать другие теплоносители или хладагенты (и в отдаленных районах расположения ГРП или ГРС).

При выборе оптимального типа ТНУ для использования в ДГА, в Республике Узбекистан (РУз) нужно учитывать различные факторы, такие как требования к эффективности и экономичности, условия эксплуатации, доступность топливных и энергетических ресурсов, экологическая безопасность и другие. Кроме того, выбор ТНУ влияет на эффективность процесса генерации электроэнергии и на затраты энергии, в том числе на затраты на привод компрессоров.

И задача эффективности работы такой установки может быть достигнута только в результате комплексного анализа потребности в электроэнергии и подогреве газа, выбора оптимального типа и работы ТНУ, а также при выборе наиболее экономичного и эффективного режима работы всех элементов системы.

Проведение расчетов с использованием различных рабочих тел и различных типов ТНУ представляет собой важный шаг в достижении максимальной эффективности и экономичности работы установки. Выбор рабочего тела должен основываться на его термодинамических свойствах, доступности, экологической безопасности и технологических факторах.

Выбор парокомпрессионной ТНУ обеспечивает возможность достижения более высокого коэффициента полезного действия по сравнению с использованием воздушных холодильных машин. При этом выбранное рабочее тело должно обладать высокой эффективностью и экологической безопасностью. Из анализа литературы [3,4] видно, что использование хладагента R134a (конденсат не переохлаждается) позволяет достичь более высокого коэффициента полезного действия по сравнению с использованием хладагента с переохлаждением.

Использование перспективного хладагента CO₂ может быть более экологически безопасным и эффективным для данной технологии. При этом следует учитывать, что CO₂ требует более высоких давлений и температур для своего использования, что может увеличить затраты на оборудование.

Применение воздушных ТНУ может быть привлекательным при условии отсутствия доступных теплоносителей, а также надо учесть, что отсутствует плата за его потребление. Кроме того, использование воздушных ТНУ может быть важным в экологически чувствительных зонах.

Проведение экспериментов

Для оптимизации работы установки необходимо проводить дополнительные исследования и анализ, учитывая все технические, экономические и экологические факторы, чтобы выбрать оптимальный тип ТНУ и рабочее тело, для чего была создана программа, интерфейс которой представлен на рис.1 [5]. Процессы, происходящие в контурах ТНУ с различными рабочими телами [6], представлены на T-S диаграммах (рис.2,3).

При проведении расчетов были использованы следующие исходные параметры:

- расход транспортируемого газа (ГРП высокого давления в РУз) $G = 9,5 \text{ кг/с}$;
- перепад давлений на входе и выходе ГРП 0,8/0,2 МПа, 1,0/0,2 МПа и 1,2/0,2 МПа;
- электромеханический КПД ДГА принимался - 0,95 [7].

Программа анализа одноступенчатого ДГА с парокompрессионным ТНУ

Файл О программе

Наименование ГРС (ГРП): Чирчик

Наименование нитки: Нитка-1

Входная температура 1: 5,00 °C

Выходная температура 2: 8,00 °C

Входное давление 1: 4,00 MPa

Выходное давление 2: 1,50 MPa

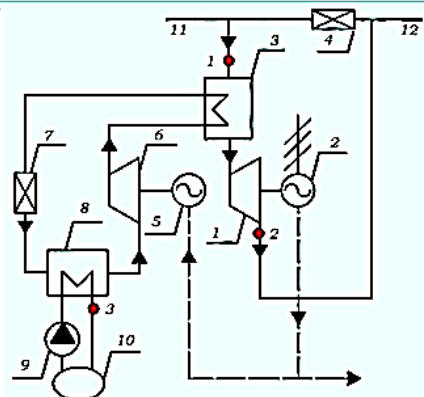
Расход газа: 10000,00 m³/h

Плотность газа: 0,71 kg/m³

Температура окружающей среды: 23,00 °C

Продолжить

Очистить



1 – детандер, 2 – генератор,
3 – подогреватель, 4 – редуктор,
5 – двигатель, 6 – компрессор,
7 – расширитель, 8 – теплообменник,
9 – насос, 10 – НИТ,
11 – вход газа, 12 – выход газа.

1 – входные параметры,
2 – выходные параметры,
3 – температура окружающей среды.

Начало работы программы

Рис. 1. Интерфейс программы «Определение доли выработанной электроэнергии при работе одноступенчатого ДГА и парокompрессионной тепловой насосной установки»

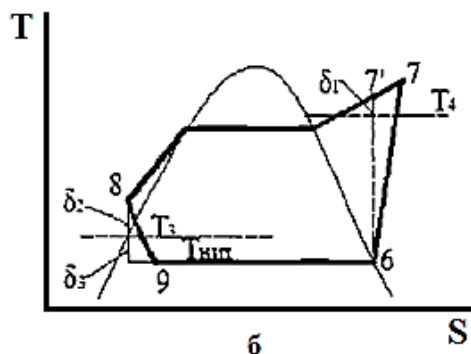
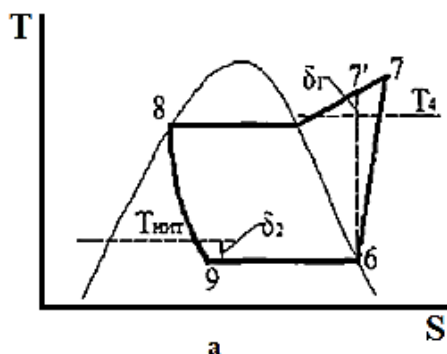


Рис.2. Процессы, происходящие в контуре парокompрессионной ТНУ, работающей на хладагенте R134a, без переохлаждения (а) и с переохлаждением (б) конденсата

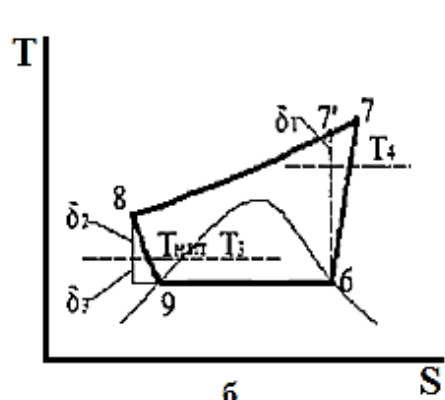
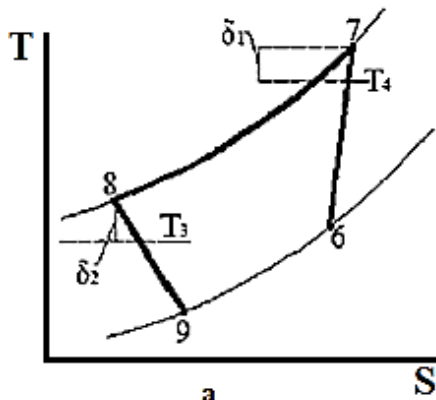


Рис.3. Процессы, происходящие в контурах парокompрессионной ТНУ, работающей на CO₂ (а), и воздушной ТНУ (б).

Для ВТНУ принимались следующие исходные параметры:

- температурная разница в системе воздух/газ в теплообменнике составляет + 5°C;

- температурная разница в системе воздух/газ в воздушном теплообменнике ТНУ составила + 12С.

Результаты расчетов представлены таблицах 1-3.

Таблица 1

Результаты расчета доли электроэнергии, выдаваемой в сеть, при использовании для подогрева газа различных ТНУ и давлении на входе и выходе станции технологического понижения давления 0,8/0,2 МПа

Наименование	Тип ТНУ	Температура окружающей среды, t_{oc} °С				
		0	5	10	15	20
Энтальпия газа на входе/выходе ДГА, $h_{вх}(h_{вых})$ кДж/кг	--	846,79	857,97	869,19	880,45	891,75
Температура газа на входе в ДГА, °С		79,46	86,04	92,62	99,20	105,78
Мощность, вырабатываемая ДГА, $N_{ДГА}$ кВт		1845,51	1881,01	1916,50	1951,93	1987,32
Температура газа на выходе из ДГА, °С		-3,16	1,95	7,06	12,17	17,27
Теплота, необходимая для подогрева газа, Q_1 кВт		1944,15	1994,18	2044,85	2097,21	2150,21
Мощность, потребляемая компрессором ТНУ, N_k кВт	ПК R134a без пере-охлаждения	929,57	1004,49	1096,87	1223,88	1469,66
Полезная мощность установки $N_{пол}$ кВт		915,94	876,53	819,64	728,05	517,66
Доля электроэнергии, выдаваемой в сеть, а		0,50	0,47	0,43	0,37	0,26
Мощность, потребляемая компрессором ТНУ, N_k кВт	ПК CO ₂	479,59	509,90	544,39	585,52	636,29
Полезная мощность установки $N_{пол}$ кВт		1365,92	1371,20	1372,12	1366,41	1351,04
Доля электроэнергии, выдаваемой в сеть, а		0,74	0,73	0,72	0,70	0,68
Мощность, компрессора ТНУ, N_k кВт	ВТНУ	2433,02	2490,24	2547,86	2607,50	2667,88
Мощность турбины ТНУ, N_T кВт		1294,72	1324,26	1353,84	1384,34	1414,95
Полезная мощность установки $N_{пол}$ кВт		707,21	715,03	722,49	728,77	734,39
Доля электроэнергии, выдаваемой в сеть, а		0,38	0,38	0,38	0,37	0,37

Таблица 2

Результаты расчета доли электроэнергии, выдаваемой в сеть, при использовании для подогрева газа различных ТНУ и давлении на входе и выходе станции технологического понижения давления 1,0/0,2 МПа

Наименование	Тип ТНУ	Температура окружающей среды, t_{oc} °С				
		0	5	10	15	20
Энтальпия газа на входе/выходе ДГА, $h_{вх}(h_{вых})$ кДж/кг	--	844,46	855,73	867,02	878,35	889,71
Температура газа на входе в ДГА, °С		92,94	99,83	106,71	113,60	120,47
Мощность, вырабатываемая ДГА, $N_{ДГА}$ кВт		2170,42	2212,73	2254,90	2297,06	2339,11
Температура газа на выходе из ДГА, °С		-4,23	0,93	6,07	11,22	16,35
Теплота, необходимая для подогрева газа, Q_1 кВт		2301,68	2362,42	2422,95	2486,23	2550,25
Мощность, потребляемая компрессором ТНУ, N_k кВт	ПК R134a без пере-охлаждения	1374,19	1542,44	1866,81	358,47	354,69
Полезная мощность установки $N_{пол}$ кВт		796,23	670,29	388,09		
Доля электроэнергии, выдаваемой в сеть, а		0,37	0,30	0,17	-	-
Мощность, потребляемая компрессором ТНУ, N_k кВт	ПК CO ₂	628,13	667,91	713,42	768,21	836,34
Полезная мощность установки $N_{пол}$ кВт		1542,29	1544,82	1541,48	1528,86	1502,76
Доля электроэнергии, выдаваемой в сеть, а		0,71	0,70	0,68	0,67	0,64
Мощность, компрессора ТНУ, N_k кВт	ВТНУ	2827,68	2896,80	2965,31	3037,47	3110,16
Мощность турбины ТНУ, N_T кВт		1454,91	1489,23	1525,48	1558,36	1594,11
Полезная мощность установки $N_{пол}$ кВт		797,65	805,17	815,07	817,95	823,06
Доля электроэнергии, выдаваемой в сеть, а		0,37	0,36	0,36	0,36	0,35

Таблица 3

Результаты расчета доли электроэнергии, выдаваемой в сеть, при использовании для подогрева газа различных ТНУ и давления на входе и выходе станции технологического понижения давления 1,2/0,2 МПа

Наименование	Тип ТНУ	Температура окружающей среды, $t_{oc}, ^\circ\text{C}$				
		0	5	10	15	20
Энтальпия газа на входе/выходе ДГА, $h_{вх}$ ($h_{вых}$), кДж/кг	--	842,13	853,47	864,84	876,24	887,67
Температура газа на входе в ДГА, $^\circ\text{C}$		103,91	111,07	118,22	125,36	132,51
Мощность, вырабатываемая ДГА, $N_{дга}$, кВт		2439,70	2487,80	2535,82	2583,68	2631,49
Температура газа на выходе из ДГА, $^\circ\text{C}$		-5,30	-0,10	5,08	10,26	15,43
Теплота, необходимая для подогрева газа, Q_1 , кВт		2599,86	2669,40	2740,74	2812,82	2886,70
Мощность, потребляемая компрессором ТНУ, N_k , кВт	ПК Я134а без пере-охлаждения	1943,84	-	-	-	-
Полезная мощность установки $I_{пол}$, кВт		495,87	-	-	-	-
Доля электроэнергии, выдаваемой в сеть, а		0,20	-	-	-	-
Мощность, потребляемая компрессором ТНУ, N_k , кВт	ПК CO ₂	762,70	811,65	868,57	942,05	1022,63
Полезная мощность установки $I_{пол}$, кВт		1677,00	1676,15	1667,25	1641,62	1608,86
Доля электроэнергии, выдаваемой в сеть, а		0,69	0,67	0,66	0,64	0,61
Мощность компрессора ТНУ, N_k , кВт	ВТНУ	3157,37	3236,11	3317,29	3398,67	3482,76
Мощность турбины ТНУ, N_t , кВт		1581,71	1618,92	1658,67	1696,23	1736,85
Полезная мощность установки $N_{пол1}$, кВт		864,05	870,62	877,20	881,24	885,58
Доля электроэнергии, выдаваемой в сеть, а		0,35	0,35	0,35	0,34	0,34

Анализ полученных результатов

Результаты расчетов графически представлены на рис.4-6.

На графике, представленном на рис.4, видно, что с повышением температуры и давления газа необходимо увеличить температуру подогрева, при этом добиваясь равенства энтальпий газа на входе и выходе ГРП.

На рис.5, видно, что рост вырабатываемой мощности ДГА. находится в зависимости от температуры подогрева газа и перепада давления на входе в детандер.

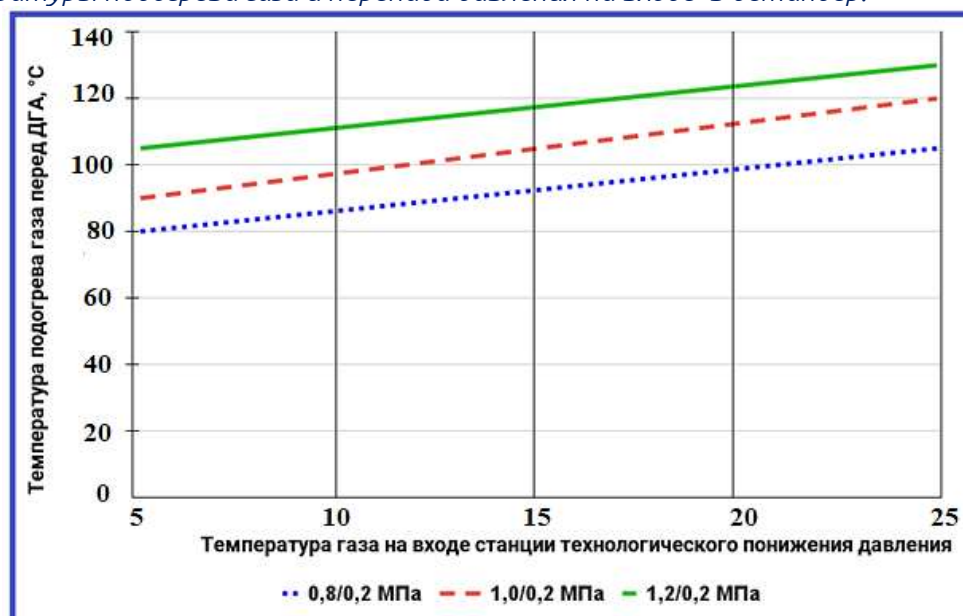


Рис.4. Влияние температуры подогрева газа до ДГА на температуру газа на входе ГРП

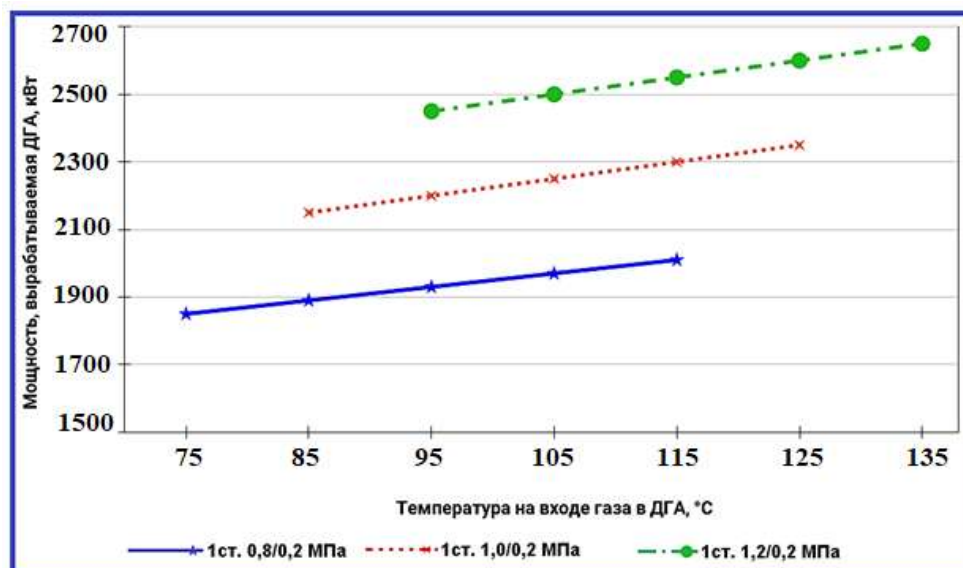
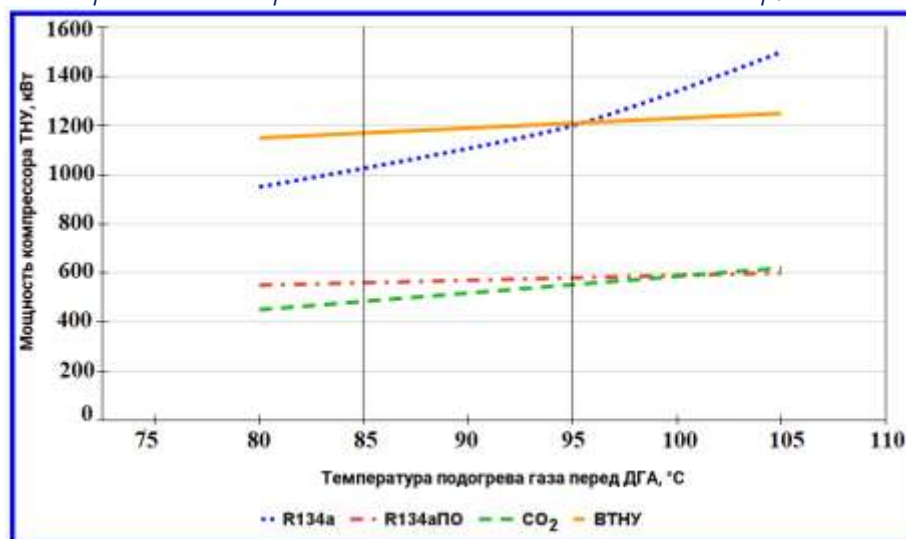
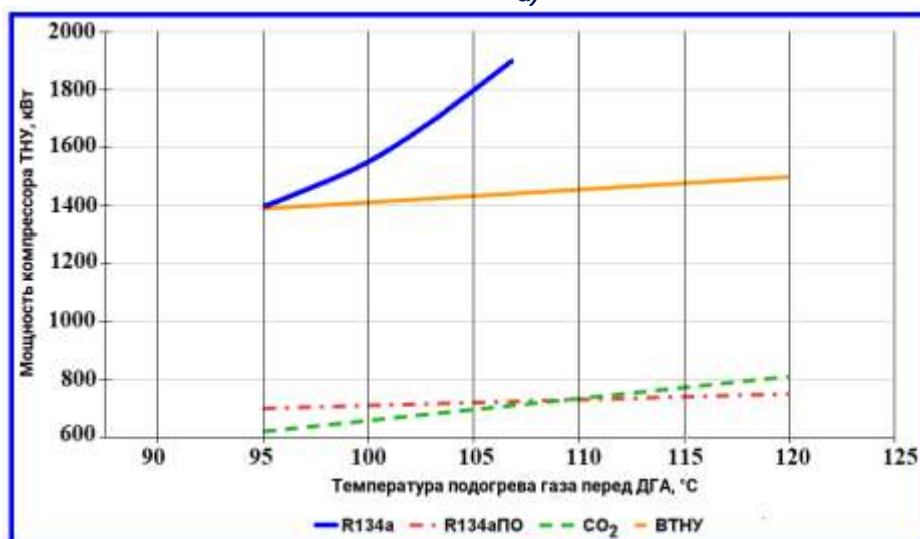


Рис.5. Влияние температуры подогрева газа и перепада давлений на входе установки на вырабатываемую мощность ДГА

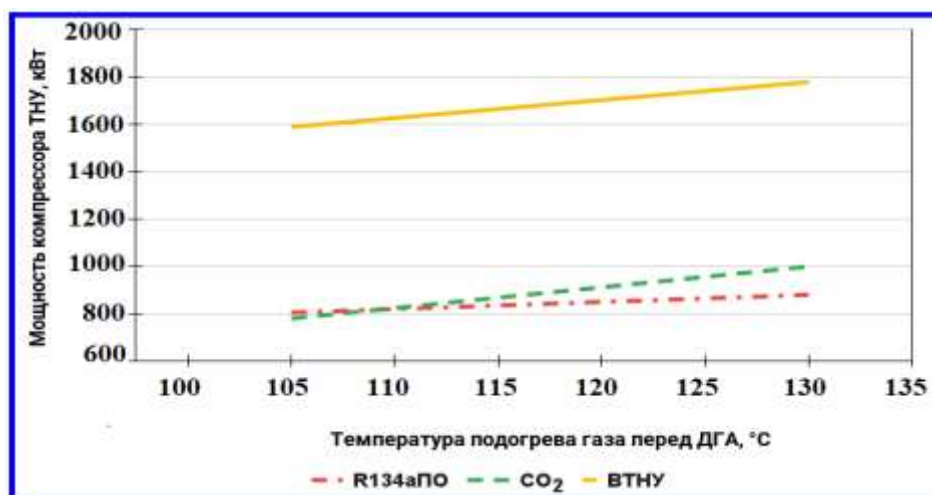
На рис.6 видно, что рост вырабатываемой мощности ДГА. находится в зависимости от температуры подогрева газа и перепада давления на входе в детандер.



а)



б)



в)

Рис.6. Влияние температуры подогрева газа перед ДГА на мощность потребляемую компрессором ТНУ

Анализируя рис. 6 замечаем:

1. При использовании разнотипных тепловых насосов мощность, потребляется компрессорами, растет с увеличением температуры подогрева газа.
2. Максимальная вырабатываемая мощность обеспечивается тепловым насосом с использованием хладагента R134a.

Выводы

Таким образом, анализ графиков и рассчитанных параметров в таблицах показывает:

1. Вырабатываемая электроэнергия, обратно пропорциональна росту температуры нагрева газа и достигает максимума для парокомпрессорных установок [79].
2. Вырабатываемая электроэнергия, обратно пропорциональна мощности, необходимой для работы ТНУ.
3. Вырабатываемая электроэнергия мала при применении воздушных ТНУ для нагрева газа перед ДГА в следующих диапазонах температур:
 - 80 ÷ 100°C при давлениях 0,8/0,2 МПа;
 - 90 ÷ 95°C при давлениях 1,0/0,2 МПа;
 - весь диапазон при давлениях 1,2/0,2 МПа.

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ANALYSIS OF METHODS AND TYPES OF DEPERSONALIZATION OF DATA**Kerimbaeva Venera**

Senior-lecturer at ATU University

Uipalakova Dinara

Senior-lecturer at ATU University

Adilbekova Aizhan

Senior-lecturer at ATU University

Toleushova Ainur

Senior-lecturer at ATU University

АНАЛИЗ МЕТОДОВ И ВИДОВ ОБЕЗЛИЧИВАНИЯ ДАННЫХ**Керимбаева Венера**

сеньор-лектор университета АТУ

Уйпалакова Динара

сеньор-лектор университета АТУ

Адилбекова Айжан

сеньор-лектор университета АТУ

Төлеушова Айнұр

сеньор-лектор университета АТУ

Abstract

This article analyzes the methods and types of depersonalization of data. The problems arising in the protection of personal and confidential data, as well as algorithms for ensuring their anonymity, are considered. Examples of attacks on personal data and ways to prevent them are given. The main methods of depersonalization are considered, including the introduction of identifiers, changing the composition or semantics, decomposition and mixing of data. The principles of operation of these methods, their advantages and disadvantages are described.

Аннотация

В данной статье проводится анализ методов и видов обезличивания данных. Рассматриваются проблемы, возникающие при защите персональных и конфиденциальных данных, а также алгоритмы обеспечения их анонимности. Приведены примеры атак на персональные данные и способы их предотвращения. Рассмотрены основные методы обезличивания, включая введение идентификаторов, изменение состава или семантики, декомпозицию и перемешивание данных. Описаны принципы работы данных методов, их преимущества и недостатки.

Keywords: *depersonalization of data, personal data, anonymity, information protection, depersonalization algorithms, digital security, mathematical model.*

Ключевые слова: *обезличивание данных, персональные данные, анонимность, защита информации, алгоритмы обезличивания, цифровая безопасность, математическая модель.*

Данные о нас собираются ежедневно, когда мы присоединяемся к организациям, собраниям или попадаем в больницу, ищем предметы первой необходимости или выполняем наши обычные повседневные упражнения. Количество эксклюзивных записей, отражающих финансы, интересы и демографические данные каждого местного жителя, увеличивается с каждым днем. Многочисленные районы предлагают регистры населения, которые включают в себя личности людей наряду с основными демографическими данными. Эта информация, которая часто публично распространяется может быть использована для связи личностей с повторно идентифицированными данными. Обстоятельства такого рода вызвали особую озабоченность в медицинской и финансовой областях, где разные данные, которые постепенно передаются для распространения или исследований, могут или были подвержены неправомерному обращению, что может привести к злоупотреблениям, тем самым угрожая частной жизни людей.

Проблема, которая исследуется в данной главе, заключается в том, как защитить данные

от косвенной атаки рассмотреть алгоритмы обезличивания ПД. Удаление уникальных идентификаторов, например, Имя, Id из таблицы не может гарантировать конфиденциальность. Повторная идентификация возможна с использованием набора атрибутов и другой базы данных, содержащей аналогичный набор атрибутов. Иногда такой подход может дополнительно раскрыть уникальные данные о человеке. Иллюстрация, изображающая атаку, демонстрируется следующим образом в таблицах 1 и 2:

Таблица 1

Данные о пациентах больницы

Дата рождения	Пол	Пин-код	Болезнь
27.03.1980	Женщина	684578	Гепатит
12.04.1988	Женщина	684674	Рак
03.08.1991	Мужчина	689643	Болезнь сердца
18.05.1985	Женщина	684987	Интерстициальный цистит

Таблица 2

Данные из других источников

Имя	Дата рождения	Пол	Пин-код
Аида	27.03.1980	Женщина	684578
Камилла	12.04.1988	Женщина	684674
Аскар	03.08.1991	Мужчина	689643
Лариса	18.05.1985	Женщина	684987

Злоумышленник может просто объединить данные из данных о пациентах больницы и информацию для участия в голосовании. В таблице 1, согласовав такие атрибуты, как дата рождения, пол и пин-код, злоумышленник может определить, что Камила страдает от рака, что является чрезвычайно конфиденциальными данными, относящимися к человеку. Поскольку совершенно очевидно, что сокрытие имени, номера телефона или других явных идентификаторов не обеспечивает безопасность конфиденциальных данных человека, таким образом, нам требуются более эффективные процедуры для достижения нашей цели. Таким образом, используя соответствующий алгоритм обезличивания данных, можно раскрыть максимальный объем данных и гарантировать, что конфиденциальность ни одного человека не будет поставлена под угрозу из-за опубликованных данных.

В ходе данной исследовательской работы было показано, что в условиях цифровизации, когда «данные в цифровой форме» становятся «ключевым фактором производства во всех сферах любой деятельности», задача обеспечения сохранности цифровых данных становится крайне важной.

В данной главе представлена математическая модель цифровых данных. Есть алгоритмы по работе с ними.

В рамках данной исследовательской работы под обезличиванием данных имеется ввиду представление персональных и/или конфиденциальных данных в виде, не позволяющем восстановить какую-либо информацию о субъекте персональных данных или о защищаемой конфиденциальной информации.

К этой информации могут быть отнесены как персональные данные, так и коммерческая или государственная тайна.

Например, при передаче данных из цифрового профиля гражданина в разные ведомства, в зависимости от конкретного бизнес-процесса, не должна передаваться информация о его лицевых счетах, информация о медицинских картах и т. д. При передаче информации между хозяйствующими субъектами, информации, составляющей банковскую, коммерческую и государственную тайну. В последнем случае, конечно, есть разные средства, в том числе принудительный доступ, создание нескольких независимых цепочек в информационной системе с разными правилами доступа. Однако с огромным ростом цифровых данных вероятность утечки информации возрастает.

Тем самым, возникает задача обезличивания персональных данных при информационном обмене, т.е. необходимость реализации в рамках функционала информационных систем некоторой функции, которая представлена в следующей формуле (1):

$$f: d_i \rightarrow d'_i \quad (1)$$

где $d_i \in D$ – исходные цифровые данные, созданные в рамках некоторой информационной системы, $d'_i \in D$ – обезличенные персональные данные, D множество цифровых данных, существующих в рамках информационного обмена. Тогда должно существовать множество

требований $T = \{NTD_i\}$, определяемых в нормативно-технической документации (НТД), которая составляет основу политик информационной безопасности, хранения и обработки персональных данных и т.д. Тем самым, правила выполнения f должны определяться в каждом конкретном случае множеством соответствующих T .

Еще одной проблемой является определить модель информационного состава d_i, d_i' , а также алгоритм работы функции f .

В целом, если говорить о постановке задачи обезличивания персональных данных, то математическая постановка задачи обезличивания персональных данных при информационном обмене данными может быть сформулирована в следующем виде:

Что мы имеем:

1) Множество цифровых данных $D = \{d_i\}$.

2) Множество требований безопасности информации $T = \{NTD_i\}$, определяемых в НТД.

Найти нужно:

1) Алгоритм реализации отображения функции $f: d_i \rightarrow d_i', d_i' \in D$, при котором исполняются требования T .

2) Математическую модель состава передаваемой информации $D = \{d_i\}$.

Для иллюстрации данной схемы постараемся визуализировать саму схему в соответствии с рисунком 1.

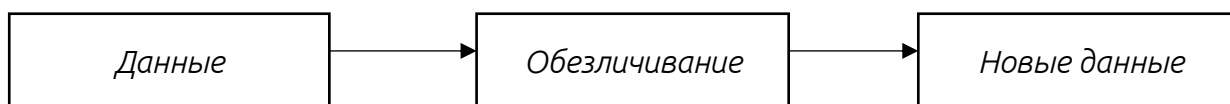


Рисунок 1 – Иллюстрация схемы функции

В процесс передачи должна быть заложена функция «обезличивания» f . Информационная система (ИС) конкретной организации должна реализовывать функцию обезличивания данных $f: d_i \rightarrow d_i'$. Входными данными функции должны быть: цифровые данные d_i , требования защиты данных $T = \{NTD_i\}$, определяющие состав «закрытых» (персональных) данных в d_i . Для поиска персональных данных может применяться интеллектуальный анализ данных, анализ, по ключевым словам, анализ состава данных и др. Кроме того, в структуре метаданных d_i должен быть предусмотрен атрибут «персональные данные», которым должны быть отмечены соответствующие данные. Данный атрибут должен устанавливаться как минимум при создании цифровых данных в исходной ИС, при изменении T , автоматически.

Выходом функции обезличивания данных f должны быть цифровые данные d_i' не содержащий персональных (закрытых) данных, возможно заверенные ЭП. Заверение ЭП необходимо для дальнейшего контроля аутентичности обезличенных данных d_i' . Хеш d_i' должен сохраняться во внешнем и приватном (эксклюзивном), возможно сохранение ЭП вместе со смарт-контрактом для проверки ЭП d_i' , для обеспечения возможности аудита в будущем. Также в блоках помещаются компоненты ЭП (сертификат открытого ключа, штамп времени).

Можно остановиться на аспектах реализации программного модуля, предназначенного для обезличивания персональных данных.

Самый простой и очевидный подход убрать персональные данные из любого набора информации – удалить непосредственно идентифицирующую информацию (имена, фамилии, адреса, номера документов и т.д.). Однако такой подход делает информацию менее ценной с точки зрения дальнейшего анализа. При этом оставшаяся информация даже с учетом того, что она не является непосредственно идентифицирующей, может использоваться для повторной идентификации.

Маскирование данных - это метод создания структурно похожей, но недействительной версии данных [Ошибка! Источник ссылки не найден.]. Целью процедуры является защита реальных данных, когда они не требуются или не могут быть переданы в исходном виде по соображениям безопасности. Когда данные замаскированы, формат данных остается неизменным. Меняются только ценности. Данные можно изменять несколькими способами, включая шифрование, перемешивание символов и замену символов или слов. Независимо от того, какой метод выбран, значения должны быть изменены таким образом, чтобы сделать невозможным восстановление исходных данных. Под маскированием понимается набор манипуляций непосредственно с идентифицирующей информацией, содержащейся в данных. В принципе, прямые идентификаторы должны быть удалены из набора данных, и такое редактирование также допустимо, что гарантирует невозможность восстановления

исходной информации, например, путем замены ее случайными значениями, сгенерированными в соответствии с определенными правилами. При таком подходе в зависимости от семантики данные могут быть заменены поддельными аналогами. Например, имена людей обычно можно заменить вымышленными именами, выбранными случайным образом из заранее составленного списка имен. Числа, такие как финансовые показатели, можно заменить произвольно сгенерированными, но в то же время значениями, действительными по смыслу или в соответствии с определенными правилами. Места, названия объектов также обычно можно редактировать аналогичным образом. Такие манипуляции с данными относительно легко выполнять со структурированными данными.

Для реализации были выбраны алгоритмы, позволяющие обрабатывать следующие категории данных, которые могут быть заменены на фиктивные:

- сочетания имени и фамилии человека;
- сочетания почтового индекса, штата и города;
- адресные строки, включающие в себя город, улицу и дом;
- даты;
- адреса электронной почты;
- случайные строки;
- номера юридических лиц;
- номера страховых полисов;
- инициалы людей;
- телефонные номера.

При обезличивании конкретного имени и фамилии выбирается случайное сочетание из подготовленного словаря. Если имя и фамилия обезличивались ранее, будут использоваться те же самые значения.

Реализованный алгоритм генерирует новое местоположение на основе существующего адреса.

Количественный анализ процедур обезличивания данных

Есть множество алгоритмов реализации процесса обезличивания, но с относительно недавнего времени были определены четыре основных метода обезличивания: введение идентификаторов, изменение состава или семантики, декомпозиция и перемешивание. Описание этих методов можно увидеть в таблице 3.

Таблица 3

Методы обезличивания персональных данных

Метод	Принцип работы	Секретность	Проблемы
Введение идентификаторов	Группа идентифицирующих атрибутов заменяется абстрактным идентификатором, группа хранится в отдельной таблице.	Таблица перекрестных ссылок	– Выбор состава идентифицирующей группы; – Генерация идентификатора; – Обеспечение связи.
Изменение состава или семантики	Изменяется структура (количество, положение, размер полей) или изменяется значение идентифицирующих атрибутов.	Алгоритм модификации	– Выбор состава идентифицирующей группы; – Генерация алгоритма модификации; – Обеспечение секретности алгоритма.
Декомпозиция	База данных разделяется на много частей, информация о связях хранится в отдельной таблице.	Таблица связей	– Выбор состава частей; – Генерация связывания; – Обеспечение связи между частями.
Перемешивание	Группа идентифицирующих атрибутов перемещается в запись другого человека.	Алгоритм перемещения	– Выбор состава идентифицирующей группы; – Генерация алгоритма перемещения; – Обеспечение секретности алгоритма перемещения.

Из данной таблицы можно сделать вывод, что:

– методы идентификаторов и декомпозиции основаны на отделении идентифицирующей информации от обезличенных данных, поэтому для них общей проблемой является обеспечение связи разделенных частей во время сеанса работы. При этом идентифицирующая часть недоступна для злоумышленника во время хранения, но может быть доступна во время прочих сеансов обработки, то есть, ввод, вывод. Следует подметить, что с точки зрения реализации, такие алгоритмы этих двух методов принципиально очень близки, поэтому далее будем рассматривать их совместно;

– методы изменения состава или семантики и перемешивания основаны на скрывании расположения идентифицирующей информации в массиве обезличенных данных, поэтому общей проблемой для них является обеспечение безопасности алгоритма во время сеанса работы. При этом есть опасность вычисления алгоритма злоумышленником в любых режимах работы потому что идентифицирующая часть является общедоступной;

– общей, хотя и менее критичной одной из проблем для всех данных методов является выбор группы идентифицирующих атрибутов. Главной причиной данной проблемы является отсутствие методики количественной оценки эффективности обезличивания;

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