that can be adapted to local conditions. These examples serve as a guide for future strategies and will help optimize the process of implementing innovations. Thus, the study confirms the need for a comprehensive approach to developing Kazakhstan's technological potential, which takes into account both domestic features and international experience.

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CLUSTER ANALYSIS OF THE DEVELOPMENT POTENTIAL OF YOUTH ENTREPRENEURSHIP IN RURAL AREAS OF KAZAKHSTAN

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ANNOTATION. Depending on the level of development of demographic, economic, and infrastructural resources, the potential for youth entrepreneurship in rural areas may vary between regions. Identifying these differences will enable the development and implementation of more locally adapted support measures for young entrepreneurs. Therefore, the aim of this study is to determine the potential for youth entrepreneurship development in the regions of the Republic of Kazakhstan through cluster analysis based on their socioeconomic and infrastructural indicators. A literature review resulted in the development of a set of indicators

influencing youth entrepreneurship in rural areas. Quantitative data for each indicator was collected and analyzed using data from the Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan and the National Bank of the Republic of Kazakhstan. The cluster analysis resulted in the identification of regional groups. The strengths and weaknesses of each group were identified, and their potential for developing youth entrepreneurship in rural areas was assessed. Based on these identified strengths and weaknesses, recommendations for encouraging young entrepreneurs were developed.

KEY WORDS: youth entrepreneurship, rural entrepreneurship, young entrepreneurs, rural areas, clusters of regions by the level of potential for the development of youth entrepreneurship, level of youth entrepreneurship.

Қазақстан аймақтарының ауылдық жерлерінде жастар кәсіпкерлігін дамыту әлеуетін кластерлік талдау салыстырмалы талдау

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АНДАТПА. Демографиялық, экономикалық және инфрақұрылымдық ресурстардың даму деңгейіне байланысты облыстар арасында ауылдық жерлерде жастар кәсіпкерлігін дамыту әлеуеті бойынша бірқатар айырмашылықтар болуы мүмкін. Оларды анықтау жергілікті жағдайға неғұрлым бейімделген жас кәсіпкерлерді қолдау іс-шараларын әзірлеп, іске асыруға мүмкіндік береді. Бұл зерттеу жұмысының мақсаты – кластерлік талдау арқылы Қазақстан Республикасы облыстарының әлеуметтік-экономикалық және инфрақұрылымдық көрсеткіштерінің негізінде олардың жастар кәсіпкерлігін дамыту әлеуетін анықтау. Әдебиеттерді талдау нәтижесінде ауылдық жерлердегі жастар кәсіпкерлігіне ықпал ететін индикаторлар және көрсеткіштер жиынтығы құрастырылды. Әрбір көрсеткіш бойынша сандық деректер Қазақстан Республикасы Стратегиялық жоспарлау және реформалар агенттігі Ұлттық статистика бюросы және Қазақстан Республикасы Ұлттық Банкі мәліметтері негізінде жинастырылып, талдау жасалынды. Кластерлік талдау нәтижесінде облыс топтары анықталды. Әрбір кластерге тән күшті және әлсіз жақтары анықталып, олардың ауылдық жерлерде жастар кәсіпкерлігін дамыту әлеуеті бағаланды. Анықталған артықшылықтар мен әлсіз жақтарына негізделе отырып, жас кәсіпкерлерді ынталандыру бойынша ұсыныстар әзірленді.

ТҮЙІН СӨЗДЕР: жастар кәсіпкерлігі, ауылдық кәсіпкерлік, жас кәсіпкерлер, ауылдық жерлер, жастар кәсіпкерлігін дамыту әлеуеті деңгейі бойынша облыстар кластерлері, жастар кәсіпкерлігінің деңгейі.

Кластерный анализ потенциала развития молодежного предпринимательства в сельских местностях регионов Казахстана

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АННОТАЦИЯ. В зависимости от уровня развития демографических, экономических и инфраструктурных ресурсов потенциал молодежного предпринимательства в сельской местности может варьироваться между регионами. Выявление этих различий позволит разработать и внедрить более адаптированные к местным условиям меры поддержки молодых предпринимателей. Поэтому целью данного исследования является определение потенциала развития молодежного предпринимательства в регионах Республики Казахстан посредством кластерного анализа на основе их социально-экономических и инфраструктурных показателей. В результате обзора литературы был составлен набор показателей, влияющих на молодежное предпринимательство в сельской местности. Количественные данные по каждому показателю были собраны и проанализированы с использованием данных Бюро национальной статистики Агентства по стратегическому планированию и реформам Республики Казахстан и Национального банка Республики Казахстан. В результате кластерного анализа были выделены региональные группы. Были определены сильные и слабые стороны каждой группы, а также оценен их потенциал для развития молодежного предпринимательства в сельской местности. На основе выявленных сильных и слабых сторон были разработаны рекомендации по поощрению молодых предпринимателей.

КЛЮЧЕВЫЕ СЛОВА: молодежное предпринимательство, сельское предпринимательство, молодые предприниматели, сельская местность, кластеры регионов по уровню потенциала развития молодежного предпринимательства, уровень молодежного предпринимательства.

INTRODUCTION. The success of an entrepreneurial activity depends not only on the entrepreneur himself, but also on the geographic location in which it is carried out. Local resources play a crucial role in the success of youth entrepreneurship. In addition to the traits of entrepreneurs, the conditions for conducting entrepreneurial activities, such as local workforce, natural environment and infrastructure, and financing channels, are all important development factors.

Besides the differences in entrepreneurial activities between countries, there may also be differences between different regions within the same country. Due to differences in population, geography, and socioeconomic characteristics, the dynamics of youth entrepreneurship vary between urban and rural areas and between different regions. Each region may possess its own resources needed for entrepreneurial development, and entrepreneurs can utilize these resources to take advantage of opportunities and achieve success [1]. Furthermore, such entrepreneurial incentives may exist simultaneously in multiple regions. Therefore, in entrepreneurship research, it is essential to group different regions into clusters and analyze them.

Cluster analysis is widely used in entrepreneurship research. This analytical method is often used in the study of entrepreneurial ecosystems, entrepreneurs, or types of entrepreneurship [2]. It can help us identify the strengths and weaknesses of rural entrepreneurial ecosystems in different regions and help create new opportunities for the development of youth entrepreneurship in areas based on abundant resources. This study aims to identify the potential for youth entrepreneurship development in regions of the Republic of Kazakhstan through cluster analysis, based on socioeconomic and infrastructure indicators.

By clustering indicators of human resources, innovation, and financial resources in different regions, our research makes several scientific and practical contributions to research on rural youth entrepreneurship. First, this study collected data on the regional distribution of socioeconomic resources influencing youth entrepreneurship. Second, based on the similar socioeconomic characteristics of youth entrepreneurship, different regions were grouped into clusters. Furthermore, based on the strengths and weaknesses of each cluster, we propose recommendations to promote youth entrepreneurship development. These research findings can be used not only for theoretical research but also for practical applications, such as regional activities to promote youth entrepreneurship.

MATERIALS AND METHODS OF RESEARCH. In this study the following methods were employed:

Document analysis. A review of scientific literature and statistical data related to youth entrepreneurship and rural entrepreneurship, at the regional and national levels was conducted. Based on this, a set of key factors and indicators for cluster analysis was developed.

Statistical Analysis. Cross sectional data on youth entrepreneurship indicators in rural areas were collected and analyzed from the Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan and the National Bank of the Republic of Kazakhstan.

Cluster Analysis. Cluster analysis was performed using the Python programming language. Cluster analysis grouped regions based on the similarity characteristics of entrepreneurship indicators. Quantitative data were standardized. A two-stage clustering procedure was employed. The elbow method based on the k-means algorithm was used to test and determine the number of clusters. Due to the small sample size, hierarchical clustering was used. Euclidean distance was chosen to calculate the distance between the analyzed objects. The Ward method was used to merge clusters. The stability of the grouped regions was tested using the k-means method. The results show that cluster analysis of entrepreneurship at the regional level enables us to make recommendations to support young entrepreneurs based on potential factors in each region.

RESULTS AND THEIR DISCUSSION. Doing business in areas with a high proportion of R&D investment can provide many opportunities for rural entrepreneurs. This enhances the attractiveness of the local entrepreneurial ecosystem, which in turn attract entrepreneurs or young people with entrepreneurial intentions from other areas. As a result, this contribute to the revitalization of rural areas [3]. A large number of studies have shown that the impact of human capital is not only reflected at the individual level (i.e., the entrepreneur level), but the local residents' education level also affects the success of entrepreneurs [4]. In the literature on entrepreneurship, one of the main indicators of infrastructure is the quality of roads and internet accessibility. Digital access, as one of the external factors affecting entrepreneurship, can increase the number of new entrepreneurs [5]. The existing literature presents a number of views on the impact of regional unemployment on entrepreneurship. First, a high unemployment rate may leads to a lack of other means of livelihood for individuals, encouraging them to start entrepreneurial activities. This means that a high unemployment rate will increase the number of new entrepreneurs. However, some studies argue that a high unemployment rate does not necessarily bring economic opportunities for entrepreneurship. In this regard, areas with low unemployment rates are characterized by strong demand and superior entrepreneurial conditions. The impact of unemployment on entrepreneurship may also depend on the level of economic development of the region. That is, in regions with higher economic indicators, unemployment has a positive impact on entrepreneurship, conversely, in regions with slow economic growth, unemployment has a negative impact [6]. Insufficient start-up capital for young entrepreneurs is one of the man barriers. Among the main obstacles to the integration of youth into entrepreneurship, one of the most significant is the difficulty of attracting start-up capital and limited access to financial resources [7]. In this study, based on the research of Stuetzer et al. (2018) current bank accounts per capita in financial institutions are considered as indicators of access to financial capital. In addition to its long-term stable correlation with economic growth [9], fixed capital investment can also impact overall entrepreneurial activity in the early stages [10]. Therefore, this study included fixed capital investment indicators for each region.

The study also considered the proportion of rural youth population in each region, as this is the foundation for future youth entrepreneurship. Because regions with a larger proportion of young population have greater potential for entrepreneurship development, especially in the long term. Previous studies have found the link between demographic structure, entrepreneurship, and economic growth. According to them countries with a high proportion of youth population tend to have higher levels of entrepreneurship, but slower economic growth [11].

Based on a literature review, we developed a set of indicators to assess the potential for youth entrepreneurship development at the regional level. For the regional quantitative data for each indicator, data from the Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan [12] and the National Bank of the Republic of Kazakhstan [13] were used (table 1).

Table 1 – Assessment indicators for youth entrepreneurship development potential in regions

Indicator	Indicator description
Level of development of youth entrepreneurship	Youth entrepreneurship rate
Human capital	Proportion of educated population
	Proportion of youth population
Economic development	Youth unemployment rate
Internet infrastructure	Number of internet users (regardless of geographic location)
Financial capital	Current bank accounts per capita
Investment activity	Per capita fixed capital investment
Innovation potential	R&D expenditure as a percentage of GDP

Note: Compiled based on [12; 13] data sources

The regions with the highest youth entrepreneurship activity were Ulytau (16.2%), Almaty (11.9%), Karaganda (10.6%), Zhambyl (10.3%), Mangystau (10.1%), Kyzylorda (9.7%), and Turkistan (9.6%) regions.

These regions also lead in the proportion of youth population. Regarding education level, the regions with the highest rates were North Kazakhstan (55.3%), Kostanay (53.2%), Pavlodar (53.2%), Akmola (52.6%), Abai Region (51.6%), West Kazakhstan (51.6%), and East Kazakhstan (51.0%) regions. The regions with the highest youth unemployment rates are Ulytau (4.2%), East Kazakhstan (4.1%), West Kazakhstan (4.0%), Akmola (3.9%), Kyzylorda (3.8%), Zhambyl (3.7%), and North Kazakhstan (3.7%) regions (table 2).

Compared to other regions, Kostanay (97.6%), Karaganda (97.2%), Turkistan (96.3%), Mangystau (94.7%), Aktobe (93.5%), and Akmola (93.4%) regions have a higher number of internet users.

The regions with the highest values of current bank accounts per capita are Atyrau (369500.9), Karaganda (278772.8), Mangystau (216998.1), and Aktobe (215060.6) regions. These regions, especially Atyrau (4769.5), and others such as Aktobe (2078.9), Karaganda (2011.4), Mangystau (1637.3), and West Kazakhstan (1784.2) regions also have higher per capita fixed capital investment. In terms of the R&D expenditure as a percentage of GDP, Mangystau (0.345%), Abay (0.22%), East Kazakhstan (0.22%), and Zhambyl (0.17%) regions have relatively high percentages (table 3).

Table 2 – Youth entrepreneurship and unemployment rates, and human capital

	Youth entrepreneurship rate,%	Proportion of youth population,%	Proportion of educated population,%	Youth unemployment rate,%
Abay region	8,0	24,10	51,60	3,4
Akmola region	6,1	26,90	52,60	3,9
Aktobe region	8,8	28,60	48,90	1,4
Almaty region	11,9	28,30	49,10	2,7
Atyrau region	6,5	30,20	45,60	3,0
West Kazakhstan region	7,7	27,30	51,60	4,0
Zhambyl region	10,3	30,00	45,80	3,7
Zhetisu region	7,4	26,90	42,60	2,4
Karaganda region	10,6	27,00	50,10	1,8
Kostanay region	6,0	26,30	53,20	3,0
Kyzylorda region	9,7	30,10	39,00	3,8
Mangystau region	10,1	30,70	43,20	2,4
Pavlodar region	5,7	25,70	53,20	1,7
North Kazakhstan region	4,6	24,20	55,30	3,7
Turkistan region	9,6	31,20	39,00	2,1
Ulytau region	16,2	27,80	48,00	4,2
East Kazakhstan region	6,0	23,80	51,00	4,1

Note: Compiled based on [12] data sources

Table 3 – Indicators of infrastructure development, innovation potential, financial factors, and investment activities in regions

	Number of internet users (regardless of geographic location)	R&D expenditure as a percentage of GDP	Current bank accounts per capita	Per capita fixed capital investment
Abay region	84.8	0.22	139808.30	1382.3
Akmola region	93.4	0.11	142882.90	1002.4
Aktobe region	93.5	0.07	215060.60	2078.9
Almaty region	92.7	0.06	41642.70	614.4
Atyrau region	86.3	0.01	369500.90	4769.5
West Kazakhstan region	82.8	0.04	202529.50	1784.2
Zhambyl region	87.9	0.17	92520.60	414.4
Zhetisu region	90,9	0.04	101670.90	890.4
Karaganda region	97,2	0.11	278772.80	2011.4
Kostanay region	97.6	0.05	185687.90	660.1
Kyzylorda region	89.3	0.05	145615.30	829.5
Mangystau region	94.7	0.34	216998.10	1637.3
Pavlodar region	91.0	0.03	207853.70	1085.0
North Kazakhstan region	91.5	0.11	172831.40	1017.6
Turkistan region	96.3	0.06	40259.20	532.4
Ulytau region	89.0	0.00	185509.80	920.2
East Kazakhstan region	90.5	0.22	201550.60	1043.3

Note: Compiled based on [12; 13] data sources

Before analysis, we standardized the collected quantitative data using z-scores. The Elbow method was used to test the possible number of clusters. The results showed that setting the number of clusters to 3 was more appropriate.

Using Ward's method to conduct hierarchical cluster analysis, we obtained the following results. For the considered entrepreneurship indicators, we identified a cluster structure consisting of three groups. Each of these groups has its own strengths and weaknesses, which is crucial for the development of youth entrepreneurship. A comprehensive analysis of the factors identified in each group allows us to determine the priority resources of each ecosystem that constitute the entrepreneurial potential of the region (Figure 1).

Table 4 – Comparison of variable means (centroids) among clusters

Indicator	F	p-value
Number of internet users (regardless of geographic location)	0.50	0.6196
R&D expenditure as a percentage of GDP	0.81	0.4649
Proportion of educated population,%	12.79	0.0007
Youth unemployment rate,%	3.08	0.0778
Youth entrepreneurship rate,%	7.53	0.0060**
Proportion of youth population,%	10.97	0.0014***
Current bank accounts per capita	13.02	0.0006***
Per capita fixed capital investment	9.05	0.0030***

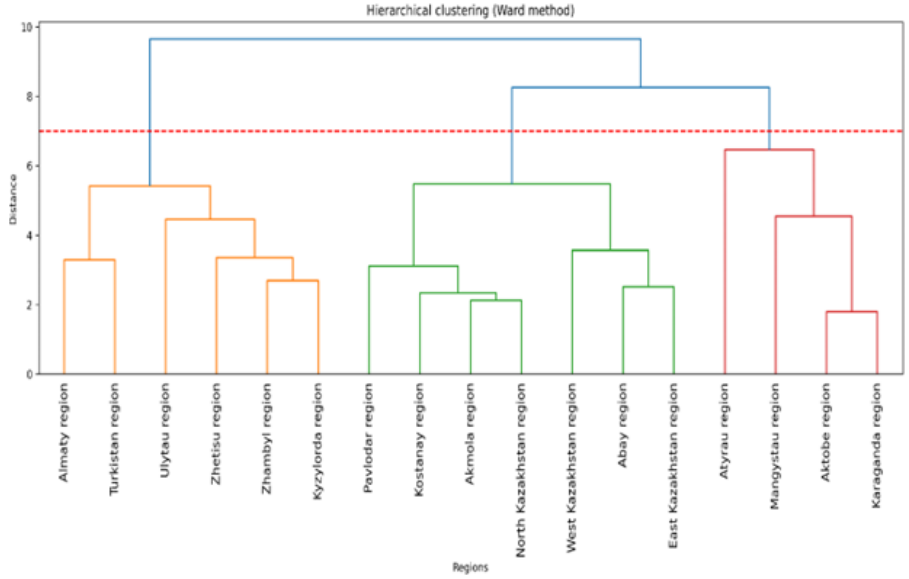


Figure 1 – Cluster analysis dendrogram of youth entrepreneurship development potential in regions of Kazakhstan.

Note: The authors used the Python programming language (SciPy, Matplotlib library).

The three clusters identified by the study have their own advantages and can serve as the basis for formulating youth entrepreneurship development strategies. The first cluster is youth labor force and youth entrepreneurs, the second cluster is human capital, namely professionals, and the third cluster is demographic and economic conditions. When developing youth entrepreneurship development programmes, the specific advantages and disadvantages of each region must be considered.

The first cluster includes Ulytau, Zhetisu, Jambyl, Kyzylorda, Almaty, and Turkistan regions. As mentioned above, the population structure of the second cluster is dominated by young people, and there are a large number of young entrepreneurs. The youth unemployment rate is relatively low. This indicates the presence of a large number of young people in the region, which contributes to the further development of youth entrepreneurship. At the same time, it can also be seen that there are some conditions in the region that can enhance the entrepreneurial willingness of young people. That is to say, the large number of young entrepreneurs can be attributed to the well-developed entrepreneurial culture in the region. Because entrepreneurial culture can enhance young people's interest in becoming entrepreneurs [14].

The second cluster includes Pavlodar, Kostanay, Akmola, North Kazakhstan, West Kazakhstan, Abay, and East Kazakhstan regions. One of the advantages of this cluster is human capital, namely the availability of the necessary workforce to promote the development of youth entrepreneurship. According to data, almost all regions of this cluster have high youth unemployment and low youth entrepreneurship rates, and a high proportion of educated population.

Table 5 – Regional clusters and characteristics based on youth entrepreneurship development potential in rural areas

Cluster – 1	Regions with high levels of youth entrepreneurship and demographic potential to its further development.
Regions	Almaty, Turkistan, Ulytau, Zhetisu, Zhambyl, and Kyzylorda regions
Description and recommendations for the development of youth entrepreneurship	Both the level of youth entrepreneurship and the proportion of the youth population are relatively high. The youth unemployment rate is average across all clusters. This creates a favorable demographic foundation for the further development of youth entrepreneurship.
Cluster – 2	The advantage of this cluster – human capital – creates favorable conditions for the development of youth entrepreneurship.
Regions	Pavlodar, Kostanay, Akmola, North Kazakhstan, West Kazakhstan, Abay, and East Kazakhstan regions
Description and recommendations for the development of youth entrepreneurship	This cluster has a high concentration of resources, indicating its entrepreneurial potential can be further developed. Human capital to form the teams needed to develop youth entrepreneurship. However, the level of youth employment and entrepreneurial activity is relatively low. This suggests the need to integrate young people into the labor market through entrepreneurship.
Cluster – 3	Regions with high demographic and economic potential are conducive to the development of youth entrepreneurship.
Regions	Atyrau, Mangystau, Aktobe, and Karaganda regions
Description and recommendations for the development of youth entrepreneurship	There are favorable demographic, financial, and investment conditions for youth entrepreneurship. Young people make up a significant proportion of the next generation of young entrepreneurs. Indicators measuring access to financial capital are at a high level. Furthermore, regions have sufficient investment opportunities to provide the resources and infrastructure for start-ups. The average level of youth entrepreneurship activity suggests that, leveraging established advantages, youth entrepreneurship has further development potential.

Note: Compiled by authors

High unemployment rates may increase the potential workforce, however, at the same time it can hinder innovation and expansion if the skills of available workers do not match the actual needs of small businesses [15]. This could be explained by the need to further realize the regions' entrepreneurial potential or by the fact that the existing workforce's skills do not meet entrepreneurs' needs. To determine which option is more realistic, future research should analyze data on higher education attainment and specializations.

The third cluster includes Atyrau, Mangystau, Aktobe, and Karaganda regions. This cluster possesses favorable demographic, financial, and investment conditions conducive to youth entrepreneurship. The high proportion of youth population indicates the region's potential to developing future young entrepreneurs. One of the key resources for youth entrepreneurship is access to financial capital, which can increase opportunities for young people in rural areas to engage in entrepreneurial activities [16]. In addition, the high fixed capital investment index indicates the region's potential to develop its resource base, thereby enhancing the level of youth entrepreneurship.

By comparing the mean (centroid) of variables among the clusters, we identified at least one pair of factors that showed statistically significant differences between the clusters. The results indicate that the regional clustering is mainly influenced by financial indicators, investment, the proportion of educated population, the proportion of youth population, and the level of entrepreneurial activity (table 4).

Through cluster analysis of entrepreneurial sectors at the regional level, we assessed the potential of each region to develop youth entrepreneurship, and based on this, we proposed a series of recommendations (Table 5).

CONCLUSION. This paper uses cluster analysis to assess the development potential of youth entrepreneurship in rural areas based on socioeconomic indicators of regions. Through literature analysis, the main factors and indicators required for the analysis were identified. Quantitative data for these factors were obtained from the the Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan and the National Bank of the Republic of Kazakhstan. This paper used data for youth entrepreneurship in rural areas of each region for 2024.

This study divides the regions into three clusters and analyzes the similarities and differences in the distribution of resources influencing youth entrepreneurship across regions. The study found that each cluster contains several factors affecting the development potential of youth entrepreneurship in rural areas. Based on the identified strengths and weaknesses, this paper proposes suggestions to encourage youth entrepreneurship.

This study has some limitations that need to be considered. First, only cross-sectional data for youth entrepreneurship in each region were used during the cluster analysis. Future research should utilize panel data for cluster analysis to identify dynamics and predict the development trend of clusters over time. Future research should also include indicators of regional industry specialization into the cluster analysis. This could contribute to the diversification of youth entrepreneurship and the access to resources needed to start a business.

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ҚАЗАҚСТАНДАҒЫ КӨЛІК-ЛОГИСТИКА КЕШЕНІНІҢ ЦИФРЛЫҚ ТРАНСФОРМАЦИЯСЫ: ЖАҒДАЙЫ, МҮМКІНДІКТЕРІ ЖӘНЕ ДАМУ ПЕРСПЕКТИВАЛАРЫ

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АҢДАТПА. Мақалада Қазақстандағы көлік-логистика кешенінің (КЛК) цифрлық трансформациясы жан-жақты талданады. Зерттеудің мақсаты – интеллектуалды көлік жүйелері (ITS), Big Data, IoT, блокчейн, жасанды интеллект және бұлттық сервистер технологияларының Қазақстан транспорт-логистика саласына ықпалын бағалау, осы процестегі негізгі кедергілерді анықтау және трансформацияны жеделдетуге бағытталған практикалық ұсыныстар әзірлеу. Зерттеуде жүйелік талдау, салыстырмалы-сараптамалық, корреляциялық-регрессиялық, экономикалық бағалау және SWOT-талдау әдістері қолданылды. Нәтижесінде: Қазақстанның ОАА аймағындағы сенімді LPI көшбасшылық позициясы дәлелденді; GCI мен LPI арасындағы r=0,94 корреляция IT-инвестициялардың тікелей ықпалын растайды; SWOT-матрица арқылы саланың 5 күшті жағы, 5 әлсіздік, 5 мүмкіндік және 5 қауіп-қатер жүйеленді; 6 негізгі кедергі санаты анықталып, шешу жолдары ұсынылды; «Инновациялық даму» технологиялық платформасының концептуалдық үлгісі мен 2025–2030+ жылдарға арналған кезеңдік жол картасы синтезделді.

ТҮЙІН СӨЗДЕР: цифрлық трансформация, көлік-логистика кешені, интеллектуалды көлік жүйелері, Big Data, IoT, логистика тиімділігі индексі, SWOT-талдау.

Цифровая трансформация транспортно-логистического комплекса Казахстана: состояние, возможности и перспективы развития

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АННОТАЦИЯ. В статье проводится комплексный анализ цифровой трансформации транспортно-логистического комплекса (ТЛК) Казахстана. Цель исследования – оценить влияние технологий интеллектуальных транспортных систем (ITS), Big Data, IoT, блокчейн, искусственного интеллекта и облачных сервисов на транспортно-логистическую отрасль Казахстана, выявить основные барьеры данного процесса и разработать практические рекомендации по ускорению трансформации. В исследовании применялись методы системного анализа, сравнительно-аналитический, корреляционно-регрессионный, экономической оценки и SWOT-анализ. В результате: подтверждено лидерство Казахстана по LPI в регионе ЦАА; корреляция r=0,94 между GCI и LPI подтверждает прямое влияние IT-инвестиций; через SWOT-матрицу систематизированы 5 сильных сторон, 5 слабостей, 5 возможностей и 5 угроз отрасли; выявлены 6 основных категорий барьеров с предложением путей их преодоления; синтезированы концептуальная модель технологической платформы «Инновационное развитие» и поэтапная дорожная карта на 2025–2030+ гг.

КЛЮЧЕВЫЕ СЛОВА: цифровая трансформация, транспортно-логистический комплекс, интеллектуальные транспортные системы, Big Data, IoT, индекс эффективности логистики, SWOT-анализ.

Digital transformation of the transport and logistics complex of Kazakhstan: status, opportunities and development prospects

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ABSTRACT. The article provides a comprehensive analysis of the digital transformation of the transport and logistics complex (TLC) of Kazakhstan. The purpose of the study is to assess the impact of Intelligent Transportation Systems (ITS), Big Data, IoT, blockchain, artificial intelligence and cloud services on Kazakhstan's transport and logistics sector, identify key barriers and develop practical recommendations to accelerate the transformation. The study applied systematic analysis, comparative-analytical, correlation-regression, economic evaluation and SWOT-analysis methods. As a result: Kazakhstan's reliable LPI leadership position in the CAC region was confirmed; the correlation r=0.94 between GCI and LPI confirms the direct impact of IT investments; via SWOT-matrix, 5 strengths, 5 weaknesses, 5 opportunities and 5 threats of the industry were systematized; 6 major barrier categories were identified with proposed solutions; a conceptual model of the 'Innovative Development' technological platform and a phased roadmap for 2025–2030+ were synthesized.

KEYWORDS: digital transformation, transport and logistics complex, intelligent transport, Big Data, IoT, performance index, SWOT-analysis.