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Evaluation of competitiveness of the logistic infrastructure of the Black Sea region in the context of sustainable development strategy

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Abstract

The article proposes a methodical approach to assessing the competitiveness of enterprises in the logistics infrastructure of the Black Sea region in the context of the strategy of the development of the Black Sea. The article is presented is the author's interpretation of the steel development of the territory and injected into the logistic infrastructure. It was proposed of the methodical approach to assessing the competitiveness of enterprises-moving enterprises in the development of the territory, as one of the stages of the methodology for assessing the development of the territory in the region. It have been identified Indicators for assessing sustainable development in assessing the competitiveness of key enterprises in the region and in terms of using the TOPSIS model. The application of the TOPSIS model allows to assess the value of the aggregate indicator of sustainable development of a region or territory, taking

into account the impact of the level of competitiveness of its key enterprises. In the context of this approach, it is studied and evaluated the level of competitiveness of powerful enterprises of the Black Sea region, which form the logistics infrastructure of the region. It was determined their influence on the strategy of sustainable development of the territory. This approach allowed to expand the methodology for assessing the assessment of sustainable development of the territory through the methodology of assessing the competitiveness of enterprises-engines of development of the territory, as one of the stages of the overall methodology.

Keywords: Logistics infrastructure, Sustainable development strategy, Competitiveness assessment, Sustainable development assessment indicators, Transportation economics, Ssustainable economic growth.

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Introduction

The UN Sustainable Development Goals call for new approaches to the use and management of regional resources in the context of their strategic goals. In the concept of sustainable development, significant attention is paid to the formation of logistics infrastructure of the regions in achieving competitiveness as one of the priorities of the strategy of regional development. Achieving the planned indicators of strategic development of the regions, including the Black Sea coast, primarily depends on the integration of the regions into the international financial, human and transport corridors. That is why increasing the competitiveness of logistics infrastructure is one of the important tasks of the development of territorial communities in the region, which has a strong logistics and economic potential. Despite the fact that the last two years pandemic COVID-19 had an impact on the strategic map of many parts of the world, the demands for sustainable development are growing. Thus, the UNCTAD / MIR / 2020 report focuses on investment trends for sustainable development. n this context, it is noted that the pace and scale of further economic development of countries and territories depend on the introduction of three key technologies, namely: automation and robotics, expanding the digitalization of supply chains and layered printing technologies. However, the application of these technologies requires their compliance with emission targets, compliance with environmental, social and management standards, changes in goods and technologies under the influence of the market and ensuring sustainability in supply chains (World Investment Report, 2020). Thus, the achievement of sustainable development goals can be ensured only through the modern logistics infrastructure of regions and

territories. Trends in the field of sustainable development also have a significant impact on regional processes, by attracting regional investment in territorial clusters. These processes require regions and territories to develop sustainable development strategies, the main focus of which is competitiveness. This updates the study whose purpose is to develop methodology for assessing the competitiveness of enterprises logistics infrastructure that is central to regional economic clusters Black Sea region as a major step methodology for assessing sustainable development. The region is strategically important in the formation of international transport corridors and logistics routes in supply chains.

Literature Review

The term "sustainable development" was officially adopted at the UN World Conference on Environment and Development, in Rio de Janeiro in 1992. By definition, the Commission on Sustainable Development, the aim of sustainable development is to meet the needs of modern society without compromising the ability of future generations to meet their needs (Sustainable Development Goals 2016-2030, UN).

Fairness and sustainability of resource use are key factors in choosing the path to a safe, environmentally friendly and prosperous world for all. In September 2015, within the framework of the 70th session of the UN General Assembly, a UN Summit was held in New York, during which a general vision of new development guidelines for 2030 was provided and 17 Sustainable Development Goals were identified (Chukurna, Niekrasova et al., 2020). The proposed targets have a wide scope, since their framework provides for consideration of interrelated elements of sustainable development: economic growth, social inclusion and environmental protection. On January 1, 2016, the countdown began - the world is 15 years old to achieve 17 ambitious Sustainable Development Goals (Sustainable Development Goals 2016-2030, UN). It should be noted that the new UN Sustainable Development Goals emphasize the need to intensify sustainable development of industrial enterprises (to promote sustainable, inclusive and sustainable economic growth, full and productive employment and decent work for all (goal 8) and ensure the transition to rational consumption patterns and production (goal 12) (Zakharchenko, 2015).

Sustainability is becoming an increasingly important strategic priority for most businesses. Businesses have become aware of the need to balance their economic performance with social responsibility and environmental protection to maintain a strong position in highly competitive regional and global markets. In recent years, the concepts of corporate sustainability (CSR), corporate social responsibility (CSR), environmental management (EM) have received increasing attention, as scientists Moore S.B. (Moore and Manring, 2009), Robert K.H. (Robert, 2000), Saltzman O. (Saltzman et al., 2005), Hopkins M.S. (Hopkins, 2009) and practitioners.

There are a lot of number aspects of interpretations of sustainable development in the scientific literature (Table 1).

Table 1. Aspects of interpretation of the concept of "sustainable development"

Aspect	Components
Political and legal	I) the development of modern democracy; 2) the system of reasonable legislation; 3) social justice; 4) ensuring the freedom and equality of all people before the law; 5) coordination of governmental and public structures in ensuring the noosphere development of society.
Economical	1) reasonable combination of all forms of ownership in the national economy, civilized commodity market economy; 2,) demonopolization and free competition of producers and consumers; 3) production of agricultural and industrial products, cultural goods in sufficient quantities to meet basic living needs; people.
Ecological	1) ensuring the co-evolution of society and nature, human and the biosphere, restoring the relative harmony between them, the focus of all transformations on the formation of the noosphere (noospherogenosis); 2) preservation of ecological opportunities of economic development for the next generations; 3) theoretical development and practical implementation of methods of efficient use of natural resources; 4) ensuring ecological safety of noosphere development; 5) wide development of biotechnologies and introduction of low-waste technologies; 6) gradual transition to alternative energy based on the use of unlimited energy sources;
Social	1) elimination of hunger, poverty, unemployment; 2) caring for children and the elderly, the sick and maimed; 3) upbringing and education of children and adolescents; 4) development of a wide network of professional secondary and higher educational institutions.
International	1) struggle for peace, prevention of a new world war and regional conflicts; 2) ensuring the partnership of all countries and peoples in industry, agriculture, culture and science on the basis of equal cooperation; 3) providing comprehensive assistance to underdeveloped countries.
Informative	1) high level of development of science, technology and their implementation in practice; 2) wide distribution of public education and mass media, their truthfulness; 3) cybernetization and informatization of the national economy and culture; 4) the massive use of electronic tools to promote successful strategies for sustainable development.

Source: systematized on the basis of (Niekrasova, 2016; Saltzman, Ionescue-Somers and Steger, 2005; Zakharchenko, 2014)

But despite the variety of conceptual definitions of sustainable development, the final decision on giving priority to any of them has not yet been made. This situation is due to several reasons (Voloshin et al., 1995):

1) the semantic meaning of the term "sustainable development" can be perceived as self-sustaining, long-term, continuous, sustainable stable, balanced or supportive development;

2) the complexity of the concept, which is due to the need for a balanced combination within one definition of the triad of socio-economic development (biosphere - anthroposphere - technosphere);

3) the diversity of social, economic, environmental and other aspects of human life that must be taken into account in the definition;

4) subjectivity of factors - differences in the views and opinions of representatives of different strata of society (scientific, business, political, etc.) regarding the mechanisms of interaction of economic and environmental factors of development, their role and significance in modern conditions.

The concept of sustainable development is traditionally defined as development that "meets the needs of present generations without compromising the ability of future

generations to meet their own needs" (Zakharchenko, 2014). Thus, it is linked to the process of achieving the goal of sustainability, in which economic growth, social responsibility and environmental protection constitute the so-called concept of the triple bottom line ("triple bottom line" or in the English version "triple bottom line") (Ferova et al, 2019) and are considered as one-level, mutually complementary.

Among experts, Lozano (Lozano, 2012) was recognized and interpreted, who, considering the company in the context of its stakeholders, defined corporate sustainability as a corporate activity aimed at ensuring balance, including economic, environmental and social aspects of today, as well as their interrelationship. language in the strategic planning period.

Analyzing the literature on sustainability in a business context, we can identify at least four approaches. Supporters of one of them equate sustainability to sustainable development (Huang, 2008; Hwang and Yoon, 1981; Lankoski, 2016). And, therefore, be sure to take into account socio-environmental guidelines. In another approach, corporate sustainability is interpreted as synonymous with the concept of corporate social responsibility (Hediger, 2010; Montiel, 2008; Okoye, 2009; Gontareva et al., 2020). According to the third approach, the concept of sustainability should be directly related to the long-term competitiveness of the business (Lozano, 2015; Saltzman et al., 2005; Hopkins, 2009; Kuznetsov et al., 2020). The authors who share this view attribute a stable competitive advantage to the concept we analyzed. Proponents of the fourth approach, the concept of sustainability refers exclusively to a higher level, relative to the micro level, arguing that individual enterprises can not be sustainable. In general, within this area, the corporate organization is invested, and it contributes to the sustainable development of large systems (Bobukh, 2015). Such a variety of approaches can cause problems and issues that require further research.

Since the basis of sustainable development, as well as social responsibility, is the parity of relations in the chain "man - business - nature", the basis for building the concept of social responsibility of the enterprise in the XXI century. should be the principles of the strategy of sustainable development of the enterprise, the key of which are next (Nekrasova, Davidenko, 2014):

- the precautionary principle - to save the current state of the environment opposite irreversible change;
- the principle of "anticipate and prevent", ie, a cheaper and less risky alternative to the elimination of damage to the environment;
- the principle of greening production - the transition to environmentally friendly technologies in order to reduce the level of man-made load on the environment;
- the principle of "polluter pays" - obliges to reimburse the full cost of environmental damage;

- the principle of accountability - determines the company's level of impact of its activities on the environment and the need to take responsibility for such actions. Mandatory environmental expertise and audit of the enterprise;
- the principle of humanity - aimed at creating optimal conditions for intellectual and social development of workers, recognition of the natural right of each individual to freedom, individuality, social security and development of abilities.

In essence, we are talking about the transition from the current "economy of resource use" to the economy of their systemic reproduction. The condition for the transition to sustainable development is the organization of interaction of resource subsystems. The natural arena of such interaction is the territory. To do this, however, they must not just respond to the proposals of enterprises, but themselves to lead them, producing integrated environmental complexes and individual parts of the territory, which are specially equipped for the activities of commercial enterprises.

Thus, sustainability is the ordering of technical, scientific, environmental, economic and social resources in such a way that the resulting system is able to be maintained in a state of equilibrium in time and space (Nekrasova, Davidenko, 2014).

Methodology

As part of the assessment of the competitiveness of the Black Sea region in the context of sustainable development of the region, which is involved in several interconnected innovation and investment projects (project portfolio) of industrial production, requirements were set to achieve socio-economic development: as close as possible (to the optimistic variant of project implementation) and as far as possible from the negative variant of project implementation (to the pessimistic variant). Fulfillment of this requirement is possible by applying the method of ordered advantage due to similarity with the ideal solution (TOPSIS). In the course of this study, a modified model TOPSIS (The Technique for Order of Preference by Similarity to Ideal Solution) was used, which was first proposed by C. L. Hwang and K. Yoon in 1981 (Hwang and Yoon, 1981).

This comprehensive method of estimation, based on the calculation of the distance, is widely used for adoption, mainly in assessing the reliability of transport, information and engineering systems (Li et al., 2014; Huang, 2008; Wang and Elhag, 2006; Ghobadi and Heshmatpour, 2015; Wang and Lee, 2007; Filippova and Karpenko, 2016). The stages of application of the TOPSIS method are: construction of an index system of monitoring, evaluation and analysis of competitiveness and sustainability of the Black Sea region; application of the method of evaluation and the method of weighing indicators; assessment of the stability of calculations when changing certain parameters and assessment of structural changes in the territorial production system of the region under the influence of changes in economic relations, market processes, interregional and intersectoral relations. The TOPSIS model is able to objectively and comprehensively reflect the level of sustainable development

of the territory, calculating the degree of closeness between the assessment (current) situation in the socio-economic system and its ideal state.

In this study, we used the method of assessing competitiveness on the basis of expert assessments and determining the level of competitiveness of logistics infrastructure enterprises on the basis of calculating the polygon of competitiveness.

Results

The author's approach to the application of the TOPSIS concept to assess the competitiveness of the territory solves the problem of identifying key points of development in the context of achieving sustainable development goals. The TOPSIS methodological approach is based on determining the shortest geometric distance from the positive ideal solution (PIS) and the longest geometric distance from the negative ideal solution (NIS). In addition, it allows us to assess the competitiveness of logistics infrastructure enterprises in the context of the following three components of sustainable development:

1. The economic component of sustainable development of the territory or region involves the optimal use of limited resources and existing advantages in the territory in the field of production and services. The budgetary aspect of sustainability implies a balanced state of community finances, which allows local authorities to fully perform their responsibilities in the areas of governance.

2. The social component of sustainable development of the united territorial community is human-oriented and aimed at improving the quality of life in all its aspects: income, health care and education.

3. The ecological component of sustainable development of the united territorial community is to address issues of environmental protection, maintenance, restoration and improvement of its condition, conservation and rational use of nature.

All the above areas of sustainable development can be assessed through indicators of the impact of the enterprise on the sustainable development of the territory or region (Table 2).

The proposed indicators for assessing the impact of the enterprise on the sustainable development of the territory or region allow to assess the degree of compliance of the development of the territory with the goals of sustainable development. An important aspect in this process is the assessment of the competitiveness of key enterprises that have a significant impact on the strategic development of the region. That is why the object of this study were selected key enterprises of the regional logistics infrastructure of the Black Sea coast, which are able to form and influence the main directions of sustainable development of the territory.

Table 2. Indicators for assessing the impact of the enterprise on the sustainable development of the territory or region

Economic growth	Social development	Environmental sustainability
1. Increase in gross sub-regional product per capita area, %; 2. The share of sold innovative products in the gross subregional product, %; 3. Revenues of the general fund of the budget per capita, UAH.; 4. The level of budget subsidies, %. 5. Employment rate, %; 6. The growth rate of the number of new jobs,%; 7. Partnership development and number of projects, units; 8. Number of new enterprises, units; 9. Volume of attracted private investments in the regions, thousand UAH	1. Population, thousand people; 2. The ratio of cash income per capita and the subsistence level, times; 3. The share of the population with incomes below the subsistence level, %; 4. The growth rate of the number of working people with higher education, %; 5. Capital expenditures per capita in the region, UAH.; 6. Proportion of employees engaged in work with harmful working conditions in the number of employees, %; 7. Development of retail trade, units.	1. Volumes of emissions of polluted wastewater into water bodies, thousand cubic meters; 2. Volumes of emissions of polluted wastewater into water bodies, thousand cubic meters; 3. Area of arable land (arable land), thousand hectares; 4. The amount of funding for environmental measures from the local budget, thousand UAH. 5. Number of production enterprises that provide environmental safety, units.

(Source: development of author's)

The logistics infrastructure of the Black Sea region is a powerful system that affects not only the internal development of the region, but also its place in the international transport and logistics system. The following ports of the region are the most integrated in the logistics infrastructure of the Black Sea region at the international level: State port "Sea Commercial Port" South; Nikolaev seaport; State port "Sea Commercial Port" Chernomorsk "and the company" TIS ".

The assessment of the main indicators of port activity, which influence the development of logistics infrastructure, demonstrates their rather successful integration into the international market of logistics services. The influence of the level of world maritime trade on the development of the logistics infrastructure of the Black Sea region is also unconditional. The level of development of world maritime trade is largely determined by developments in the international economy and trade.

The unstable economic situation in the world, the impact of the COVID-19 pandemic, the trade war between the United States and China, environmental and political problems, as well as the persistent large-scale risks of declining world trade have affected maritime trade.

According to the UNCTAD report, large amounts of institutional capital in global markets are focused not on investment projects in manufacturing, but on promising projects in infrastructure, renewable energy, water and sanitation, food and agriculture, and health. That confirms the importance of logistics infrastructure in the context of sustainable development and attracts investment to the region.

Maritime transport remains the basis of global trade and the supply chain, as more than 4/5 of world trade in goods is provided by maritime transport. If we study the structure of world maritime trade in 2019 (Fig. 1), we can conclude that a significant share of bulk cargo (iron ore, grain, coal, etc.), which accounted for 31% of total cargo turnover.

Freight transportation by tankers (oil, gas, chemicals) accounted for 29% of total maritime trade. The largest share - about 40% - were other dry cargo, which includes general and container cargo.

As for Ukrainian seaports, the level of their development is improving every year, the volume of cargo turnover is growing. Among other Black Sea countries, Ukraine ranks 4th in terms of maritime cargo turnover after Turkey, Bulgaria and Russia (State Statistics Service of Ukraine, 2021).

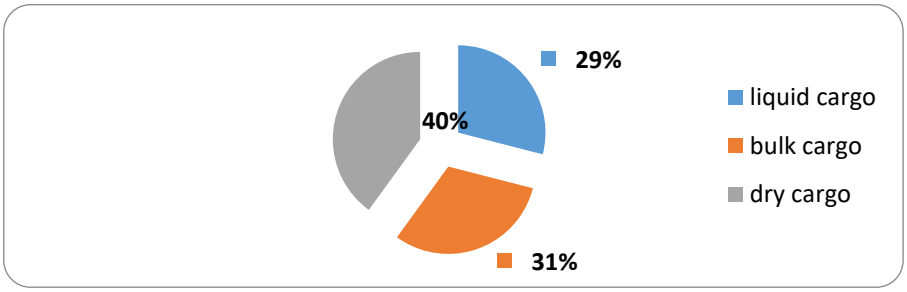


Fig.1. The structure of world trade in 2019

(Source: developed of author's on the basis of State Statistics Service of Ukraine, 2019).

However, currently the existing infrastructure capacity of all seaports in Ukraine is not fully used, although the indicators have been growing steadily over the past 5 years. Thus, the volume of transshipment in seaports of Ukraine exceeded 160 million tons in 2019, according to the press service of the Administration of Seaports of Ukraine (AMPU), which was a historic record. The growth of transshipment in 2019 was observed in all areas: exports, imports, transit and domestic transportation (Fig. 2).

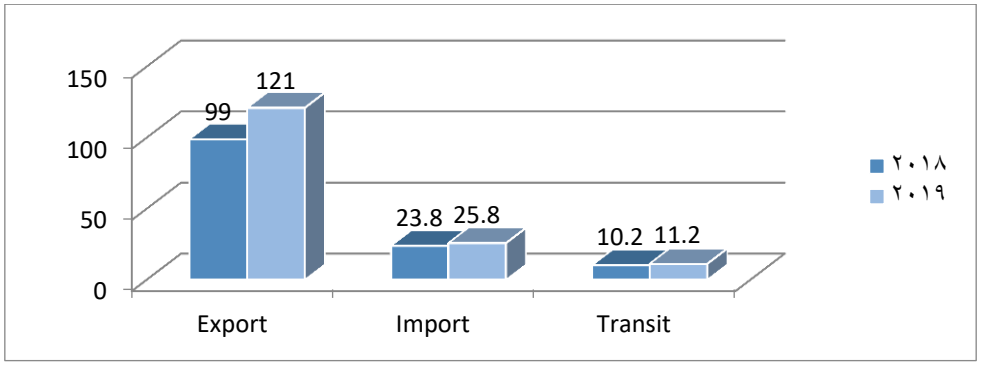


Fig.2. Changes in the volume of cargo turnover of seaports of Ukraine in 2018-2019 by areas, million tons.

(Source: developed of author's on the basis of State Statistics Service of Ukraine, 2019-2020).

The most significant was the growth of exports of Ukrainian producers, which amounted to 121 million tons, the growth rate was 22.2%. Imports increased by 8.7% to 2.58 million tons. Transshipment of transit cargo increased by almost 8% compared to the previous year to 11 million tons (State Statistics Service of Ukraine, 2019-2020).

In Ukraine, the leaders in cargo handling in 2019 were the following enterprises: logistics and stevedoring company "Transinvestservice", Black Sea, Odessa, Mykolayiv ports, the State port «Sea Commercial Port «Yuzhny» and SME "Nika-tera" (Table.3).

Table 3. The main Ukrainian stevedores in 2019

The name of the stevedore	**Volume of cargo handling, million tons**		
	2019	**2018**	**Increase**
Transinvestservice LLC	33,178	25,037	+32,5%
State port «Sea Commercial Port "Chernomorsk"	26,153	21,535	+21,4%
Odessa seaport	25,403	21,698	+17,08%
Mykolayiv seaport	24,708	23,365	+5,75%
State port «Sea Commercial Port «Yuzhny»	15,153	12,321	+23%
SME "Nika-tera"	8,670	5,84	+48%

(Source: developed of author's on the basis of State Statistics Service of Ukraine, 2019).

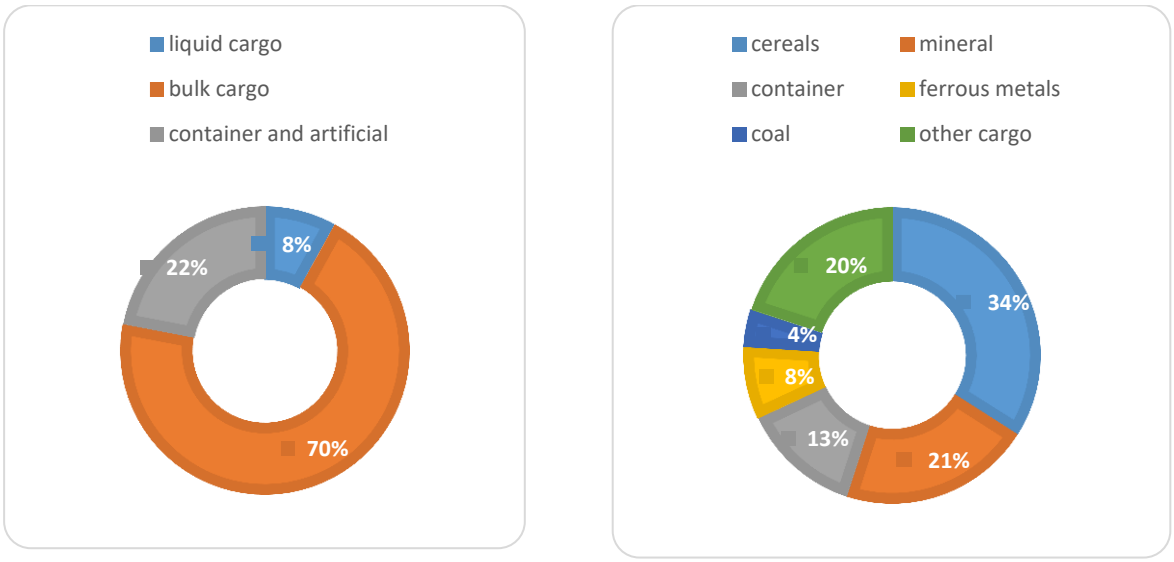
These dynamic changes in the Ukrainian ports and improving the quality of port infrastructure in Ukraine led to a significant improvement in Ukraine's position in the latest version of the ranking of global competitiveness for 2019, compiled by the method World Economic Forum. In general, Ukraine's position in the ranking decreased from 83rd to 85th place. However, Ukraine's port services and infrastructure received a score of 3.9 points (up from 3.5 last year). In general, the quality of infrastructure in Ukraine rose by 21 points from 78 to 57th place. The results of Ukraine's port activities are significantly ahead of the dynamics of other sectors of transport infrastructure, including rail and road (State Statistics Service of Ukraine, 2019-2020). The growth of indicators by ports continues for the fourth year in a row, but to call this level high, unfortunately, is not yet possible. However, the potential for further development exists.

Examining the commodity structure of Ukraine's maritime trade in 2019, it can be seen that it is based on bulk cargo, among which the leaders in terms of volume are grain cargo and ore, which account for more than half of the total cargo flow in Ukrainian ports. The three leaders among cargoes in 2019 are closed by containers - more than 1 million TEU (about 24 million tons) (Fig. 3).

Logistics and stevedoring company Transinvestservice (TIS) is the largest stevedoring operator in Ukraine and in the Black Sea region. The group of companies "TIS" includes 5 terminals: TIS-Grain, TIS-Ministry of Fertilizers, TIS-Ore, TIS-Coal and TIS-Container. Transinvestservice is one of the deepest ports in Ukraine, providing the maximum size of cargo consignments and minimum freight costs. The company constantly sets national records

for the intensity of unloading and loading of heavy tonnages. TIS terminals are access to international markets for the production and consumption of grain, fertilizers, coal, ore and consumer goods. About 700 vessels call at the TIS terminals a year and connect it to more than 1,500 ports around the world. The total cargo turnover in 2019 amounted to 25.7 million tons. The company has created more than 4,000 jobs, employing more than 20,000 people in ancillary and support services in related industries (Gornyak et al., 2019; Vovk et al., 2020).

The main competitors of the TIS group of companies are the following: State port «Sea Commercial Port «Yuzhny»; Mykolayiv seaport; State port «Sea Commercial Port "Chernomorsk".



a) Market share by mode of transportation b) Market share by type of cargo

Fig. 3. Commodity structure of maritime trade of Ukraine in 2019

(Source: developed of author's on the basis of State Statistics Service of Ukraine, 2019).

As the directions of activity, as well as the structure of exports and imports of these enterprises and the group of companies "TIS" coincide, they create competitive pressure not only in the domestic market of stevedoring services, but also internationally. A brief description of the main stevedoring companies-competitors of the group of companies "TIS" is given in table. 4.

Table 4. The main competitors of the group of companies "TIS"

Enterprise	**Characteristic**
State port «Sea Commercial Port «Yuzhny»	It is the deepest port in Ukraine (depth near berths up to 18 m). Ships with a capacity of up to 200,000 tons are accepted at berths. The company processes bulk and general cargo: coal, pellets, iron ore concentrate. The transshipment terminal is equipped with two stackers, two wagon tippers for unloading cars, a system of conveyor lines. 192.3 thousand m^3 of warehouse space is used for storage and accumulation of goods. It has its own port fleet to service transport vessels. Despite the greatest depth and high turnover, stevedoring requires significant investment in the modernization of transshipment equipment, berths, as well as the purchase

	of equipment. In addition, the processes of cargo clearance in the port of "South" are carried out manually, and the process of transporting goods from warehouses is not on conveyor lines, and cranes in several stages, which leads to additional time spent in providing stevedoring services. The company has a high level of staff turnover. In 2019, ICC «Yuzhny» increased the cargo turnover of coal and ore raw materials by 23% compared to the previous year - up to 14.541 million tons.
Mykolayiv seaport	The port is located on the left bank of the bend of the Southern Bug River. The area of the port water area is 323 ha, the territory is 69.3 ha. Navigation in the port lasts all year round. During the ice campaign, ice is towed by port tugs. It is one of the three leaders among the ports of Ukraine. Depths near the wall of berths - 9-11.2 m. 5 berths are adapted for transshipment of bulk cargo. The transport infrastructure allows the delivery of goods to the port by road, rail, sea and river, but there is a dependence on the railway station. In addition, this port has a complex and lengthy customs clearance procedure. Some port berths require major repairs and upgrades because their condition is unsatisfactory. The amount of investment to upgrade the port infrastructure is currently insufficient. The Nikolaev seaport in 2019 passed 10,736 million tons of coal ore cargoes.
State port «Sea Commercial Port "Chernomorsk"	One of the largest ports in Ukraine. The port provides: transshipment and storage of foreign trade goods of a wide range; high intensity of cargo handling at all terminals and port complexes; modern level of port works; processing of vessels of all flags and types with a maximum draft of up to 14 m .; year-round navigation and icebreaking wiring; constant information exchange with the clientele about the availability and movement of goods and vehicles. The port provides the following types of services: freight forwarding; stacking of containers; customs broker; marking and preparation of goods; towing, maintenance and repair of the fleet; transportation of goods by own motor transport. Two berths are engaged in transshipment of coal and ore products, as well as sulfur, with a total length of 420 m and a depth of 11.5 m. The gross processing intensity of the vessel is 15-18 thousand tons / day. Warehouse capacity - up to 150 thousand tons. The company is equipped with a wide variety of modern equipment for high-quality performance of its functions. The total transshipment of bulk cargo (coal, ore, coke, etc.) amounted to 5.378 mil. tons.

(Source: development of author's)

The methodological approach to assessing competitiveness is one of the stages of the methodology for assessing the level of sustainable development of the territory or region, which includes and involves the implementation of several stages. The methodology for assessing competitiveness has been adapted and supplemented with indicators for assessing sustainable development.

First, determine the competitive position of companies stevedores. We will conduct a group of stevedores, which are competitors in their characteristics. A group of companies with similar competitive strategies and market positions form a strategic group. The strongest competitors are enterprises of a strong strategic group. Changing market conditions have different effects for different groups, which can stimulate the transition from one market group to another. Increasing strategic groups (their number) in the industry can lead to increased competition.

Based on the information of the main companies stevedores, you can place them on the matrix of the competitive market map (KKR) as follows (Table 5).

Table 5. Matrix of a competitive map of the market

Market Share / **Growth rate**	**Market leaders**	**Company with a strong competitive position**	**Enterprise with weak competitive position**	**Enterprise - outsider**
The Company with a competitive position is improving rapidly	1	5 Transinvestservice LLC	9	13
The Company with a competitive position that improves	2 State port «Sea Commercial Port «Yuzhny»	6 Mykolayiv seaport	10	14
The Company with a competitive position deteriorating	3	7 State port «Sea Commercial Port "Chernomorsk"	11	15
The Enterprise competitive position of the rapidly deteriorating	4	8	12	16

(Source: development of author's)

Thus, the TIS Group of Companies can be considered an enterprise with a strong competitive position, which is growing rapidly. The closest competitor of the enterprise is State port «Sea Commercial Port «Yuzhny», which occupies the position of the 2nd matrix of the formation of KKR (when choosing a strategy of competitive behavior, the company must first focus on this competitor as the strongest). The Mykolayiv seaport occupies the 6th position and is an enterprise with a strong competitive position, and the State port «Sea Commercial Port "Chernomorsk" occupies the last 7th position among other enterprises, showing high results, but with a negative trend.

The next stage of the methodological approach to assessing competitiveness is based on assessing the main indicators that characterize the level of competitiveness of logistics and stevedoring companies. The evaluation on a 5-point scale was conducted with the participation of 3 experts-practitioners and 2 researchers in the field of stevedoring services. Experts' assessments were determined on an ordinal scale by the ranking method.

The essence of the ranking method is that in the presence of n-indicators of competitiveness in the market of logistics and stevedoring services, and according to the results of ranking by the j-th expert, each indicator receives a score of xij, ie the rank attributed to the i-th indicator by the j-th expert. The values of xij are in the range from 1 to n. The most important indicator gets the rank of the number n, and the least important - the unit.

The results of evaluation of indicators that affect the competitiveness of logistics and stevedoring companies are presented in table. 6.

Table 6. The results of a survey of experts on the competitiveness of stevedoring companies

№ expert	Competitiveness indicators								
	Quality of service provision (including processing speed of the vessel)	Depth on the approaches to ports	Compliance of the technical condition of the port with environmental standards	Development of port infrastructure	Social working conditions and Qualification of employees	Enterprise image and partner loyalty	Financial stability and solvency	The ability to attract investments	A number of additional services
1	9	4	5	6	3	8	7	2	1
2	5	6	8	9	3	7	4	1	2
3	8	5	8	4	2	7	6	3	1
4	5	4	6	7	3	9	8	1	2
5	5	6	7	9	3	2	8	4	1
The sum of ranks obtained by each indicator	32	25	34	35	14	33	33	11	7
Deviation from the average sum of ranks	7	0	9	10	-11	8	8	-14	-18
Rank sums of squared deviations	49	0	81	100	121	64	64	196	324

(Source: development of author's)

The next step in the methodology is to calculate the sum of the ranks of all five experts ∑xi. The deviation of the sum of ranks from the average sum of ranks is calculated by the formula (Bobukh, 2015):

$$\bar{B} = \left| x - \bar{x} \right|, \quad (1)$$

where, $\bar{x}$ – the arithmetic mean of the sum of ranks.

The arithmetic mean of the sum of ranks is according to the following formula:

$$\bar{x} = \frac{\bar{B}}{n}, \quad (2)$$

where, $\bar{B}$ – the sum of the ranks obtained by all options; n – number of indicators (in this case 9).

Calculate the sum of points of all indicators and the arithmetic mean of the sum of points:

$$\bar{B} = 32 + 25 + 34 + 35 + 14 + 33 + 33 + 11 + 7 = 224$$

$$\bar{x} = \frac{224}{9} = 25$$

Sums of squared deviations of scores calculated by the formula:

$$\bar{Q} = \left(x - \bar{x} \right)^2, \quad (3)$$

We will check the consistency of experts' opinions with the help of the concordance coefficient, according to the formula:

$$W = \frac{S \times 12}{m^2 \left(n^2 - n \right)}, \quad (4)$$

where, S – the sum of the squares of the deviations, m = 5 – number of experts, n = 9 – the number of evaluated indicators.

Calculate the sum of squared deviations:

$$S = 49 + 0 + 81 + 100 + 121 + 64 + 64 + 196 + 324 = 999$$

$$W = \frac{999 \times 12}{5^2 \left(9^2 - 9 \right)} = 0{,}67$$

To determine the level of agreement of experts' opinions on the concordance coefficient, use the scale presented in table. 7.

The concordance coefficient is in the range from 0 to 1, where 0 is the complete lack of consistency, and 1 is absolute consistency. The calculations show that the concordance ratio can be considered high, which indicates a high level of consistency in the opinions of experts.

Thus, the most important indicator of the competitiveness of the logistics and stevedoring company, experts consider the development of port infrastructure, as well as technical equipment, image and financial stability of the company.

Table 7. Scale for determining the level of agreement of opinions by the concordance coefficient.

The value of the coefficient	**Gradation of the level of consistency**
(0; 0,2)	opinions are almost inconsistent
(0,2; 0,4)	poor coordination of opinions
(0,4; 0,6)	notable consistency opinions
(0,6; 0,8)	good consensus
(0,8; 0,9)	strong consistency of opinion
(0,9; 1)	very high consistency, opinions almost coincide

(Source: development of author's based on Elkington,1997)

That is, the further strategy of increasing the competitiveness of the main enterprises of the logistics infrastructure of the region should be based on these areas. The least important factor was identified as a number of additional services, as according to current trends, each developed port or stevedore, in addition to transshipment, offers certain additional services, such as customs clearance, freight forwarding services, cargo clearance and more.

The next stage of implementation of the methodology of competitiveness assessment involves the assessment of the above indicators that affect the competitiveness of enterprises that form the logistics infrastructure of the region, on a 10-point scale.

The results of the evaluation are presented in table. 8-11 and summary results are presented in table. 8. The weight of indicators is determined according to the results of the preliminary analysis.

Table 8. Results of the survey of experts on the level of competitiveness of the TIS Group of Companies compared to its main competitors

Indicator competitiveness	The weight indicator	Expert №1	Expert №2	Expert №3	Expert №4	Expert №5	Overall rating
Quality of service provision (including processing speed of the vessel)	0,12	10	9	8	9	8	5,28
Depth on the approaches to ports	0,1	8	9	9	9	8	4,3
Compliance of the technical condition of the port with environmental standards	0,14	10	9	9	10	10	6,72
Development of port infrastructure	0,17	9	9	8	10	9	7,65
Social working conditions and Qualification of employees	0,08	10	9	9	10	10	3,84
Enterprise image and partner loyalty	0,13	9	10	10	9	9	6,11
Financial stability and solvency	0,13	9	10	10	9	10	6,24
The ability to attract investments	0,07	8	9	8	8	9	2,94
A number of additional services	0,06	8	7	8	9	8	2,4
TOTAL	1,0						45,48

(Source: development of author's)

Evaluation Group of Companies "TIS" received an overall assessment of 45.48 points, at what were rated highest port infrastructure, technical equipment and financial stability of the company. The results of the evaluation of international competitiveness indicators of State port «Sea Commercial Port «Yuzhny» are presented in the table (Table 9).

Table 9. The results of the survey of experts on the level of competitiveness of State port «Sea Commercial Port «Yuzhny» in comparison with its main competitors

Indicator competitiveness	The weight indicator	Expert №1	Expert №2	Expert №3	Expert №4	Expert №5	Overall rating
Quality of service provision (including processing speed of the vessel)	0,12	10	9	8	8	9	5,28
Depth on the approaches to ports	0,1	10	10	9	10	10	4,9
Compliance of the technical condition of the port with environmental standards	0,14	8	8	9	8	7	5,6
Development of port infrastructure	0,17	9	10	10	9	9	7,99
Social working conditions and Qualification of employees	0,08	9	10	9	10	10	3,84
Enterprise image and partner loyalty	0,13	10	10	10	9	10	6,37
Financial stability and solvency	0,13	9	10	8	9	9	5,85
The ability to attract investments	0,07	10	10	9	10	10	3,43
A number of additional services	0,06	9	9	8	7	8	2,46
TOTAL	1,0						45,72

(Source: development of author's)

The State port «Sea Commercial Port «Yuzhny» was received slightly higher estimates of experts on some indicators, with a total score of 45.72 points. The results of evaluation of indicators of the international competitiveness of the Mykolayiv seaport are given in tab. 10.

According to results of an assessment the Mykolayiv seaport was received 43,89 points. The latter will assess the competitiveness of State port «Sea Commercial Port "Chernomorsk" (Table 11).

Table 10. The results of a survey of experts on the level of competitiveness of the Mykolayiv seaport in comparison with its main competitors

Indicator competitiveness	The weight indicator	Expert №1	Expert №2	Expert №3	Expert №4	Expert №5	Overall rating
Quality of service provision (including processing speed of the vessel)	0,12	9	10	9	9	9	5,52
Depth on the approaches to ports	0,1	8	8	9	8	7	4
Compliance of the technical condition of the port with environmental standards	0,14	9	8	8	9	7	5,74
Development of port infrastructure	0,17	8	9	9	9	8	7,31

Social working conditions and Qualification of employees	0,08	10	10	9	8	9	3,68
Enterprise image and partner loyalty	0,13	9	9	10	9	9	5,98
Financial stability and solvency	0,13	9	8	10	9	9	5,85
The ability to attract investments	0,07	10	9	10	9	9	3,29
A number of additional services	0,06	8	9	8	9	8	2,52
TOTAL	1,0						43,89

(Source: development of author's)

Table 11. The results of the survey of experts on the level of competitiveness of State port «Sea Commercial Port "Chernomorsk" in comparison with its main competitors

Indicator competitiveness	The weight indicator	Expert №1	Expert №2	Expert №3	Expert №4	Expert №5	Overall rating
Quality of service provision (including processing speed of the vessel)	0,12	8	9	8	8	9	5,04
Depth on the approaches to ports	0,1	8	8	9	9	8	4,2
Compliance of the technical condition of the port with environmental standards	0,14	8	8	7	7	8	5,32
Development of port infrastructure	0,17	7	8	7	8	8	6,46
Social working conditions and Qualification of employees	0,08	8	9	10	9	8	3,52
Enterprise image and partner loyalty	0,13	8	8	8	9	8	5,33
Financial stability and solvency	0,13	7	6	6	7	7	4,29
The ability to attract investments	0,07	8	7	7	8	8	2,66
A number of additional services	0,06	9	8	9	9	9	2,64
TOTAL	1,0						39,46

(Source: development of author's)

The lowest score among the surveyed enterprises in State port «Sea Commercial Port "Chernomorsk". The company received low scores for financial stability, technical equipment and the ability to attract investment.

The next stage of the methodology for assessing competitiveness involves summarizing the results of assessing the competitiveness of the leading logistics and stevedoring companies in Ukraine (Table 12).

Table 12. Summary results of expert assessment of the competitiveness of leading logistics infrastructure enterprises of the Black Sea region

Indicator competitiveness	Transinvestservice LLC»	State port «Sea Commercial Port «Yuzhny»	Mykolayiv seaport	State port «Sea Commercial Port "Chernomorsk"
Quality of service provision (including processing speed of the vessel)	5,28	5,28	5,52	5,04
Depth on the approaches to ports	4,3	4,9	4	4,2
Compliance of the technical	6,72	5,6	5,74	5,32

condition of the port with environmental standards				
Development of port infrastructure	7,65	7,99	7,31	6,46
Social working conditions and Qualification of employees	3,84	3,84	3,68	3,52
Enterprise image and partner loyalty	6,11	6,37	5,98	5,33
Financial stability and solvency	6,24	5,85	5,85	4,29
The ability to attract investments	2,94	3,43	3,29	2,66
A number of additional services	2,4	2,46	2,52	2,64
TOTAL	45,48	45,72	43,89	39,46

(Source: development of author's)

In order to visualize the obtained results, we will use the method of constructing a competitiveness polygon.

This polygon will be represented by vectors directed from one point in different directions and describing the main indicators of international competitiveness of logistics infrastructure enterprises of the Black Sea region (Fig. 4).

The calculations of the assessment of the competitiveness of the enterprises of the logistics infrastructure of the Black Sea allow us to determine the most influential enterprise for the sustainable development of the region.

In our case, State port «Sea Commercial Port «Yuzhny» and the Group of Companies "TIS" (Transinvestservice LLC), occupying high competitive positions, have the most significant impact on the sustainable development of the regional logistics infrastructure of the Black Sea region.

Thus, the proposed author's approach to determining the competitiveness of key enterprises of the regional logistics infrastructure is to improve the methods of assessing sustainable development of the region based on the TOPSIS model.

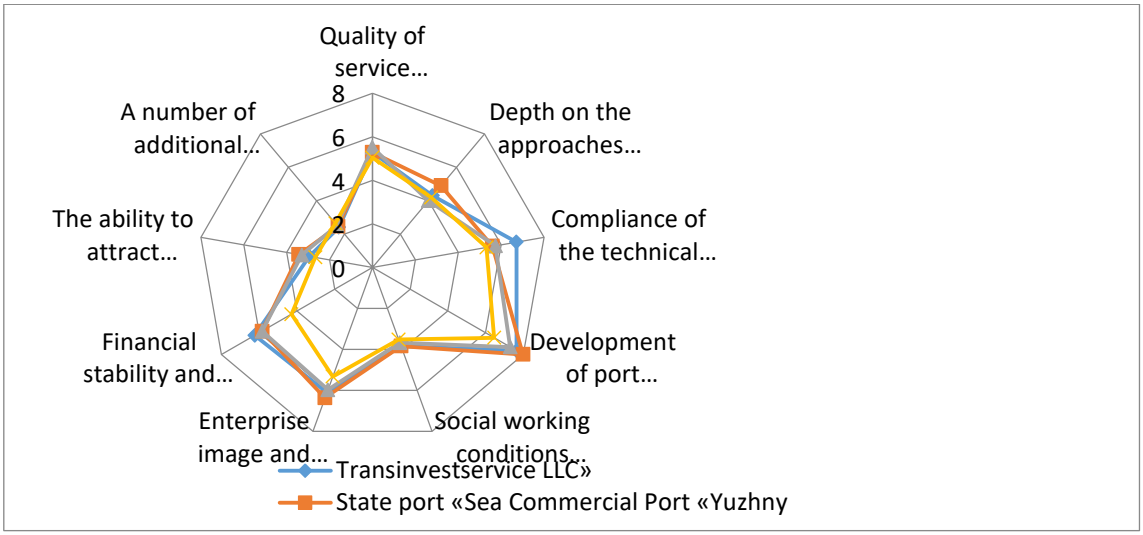


Fig.4 Polygon of competitiveness of logistics infrastructure enterprises of the Black Sea region

(Source: development of author's)

The author's vision for the application of the TOPSIS model in assessing the sustainable development of the region involves the identification and evaluation of key enterprises in the region, activities significantly affect the development of the region, stimulate innovation in the region and promote integration into the international economic space. Within the framework of the strategic goals of sustainable development, much attention is paid to the development of logistics infrastructure. In this context, assessing the competitiveness of enterprises in the logistics infrastructure of the Black Sea region, which are the main levers of influence on sustainable development of the region as a whole, should be one of the main stages of the methodology for assessing sustainable development strategy. In this context, the TOPSIS model provides a significant tool for assessing the development points of the region as a whole, but does not provide an opportunity to assess the impact of the most influential enterprises on the sustainable development of the area. Therefore, the authors of the study propose to improve the methodological approach to assessing the sustainable development of the region in terms of the use of indicators for assessing sustainable development in assessing the competitiveness of key enterprises in the region using the TOPSIS model.

The stages developed by the authors of the Methodology for assessing the sustainable development of the region are presented in table 13.

Table 13. Methods for assessing the sustainable development of the region

Stage of the methodology for assessing sustainable development	Indicator and formula for its calculation	Symbols used
1	2	3
1. Primary data processing		
1.1. Procedure for processing statistical data (in terms of aspects of sustainable development) by the method of linear scaling to reduce the values of indicators to a single unit of measurement (dimensionless quantities).	$z_{ij} = \left(x_{ij} - x_{ij}^{\min}\right) \Big/ \left(x_{ij}^{\max} - x_{ij}^{\min}\right)$	*xij* – initial value of the indicator (sustainable development indicator) for a specific object of study (territory or region); *zij* – the value of the indicator is given.
1.2. Standardization procedure for the sum of values by number of research objects (territory or region).	$\bar{s}_{ij} = Z_{ij} \Big/ \sum_{i=1}^{m} Z_{ij}$	*sij* – standardized value of the indicator (sustainable development indicator); *zij* – the value of the indicator (sustainable development indicator) for a specific object of study (territory or region).
2. Estimation of weight coefficients (significance coefficients) of indicators (indicators) of sustainability		
2.1. Calculation of the measure of entropy of the indicator (measures of deviation of the real value from the ideal).	$\varepsilon_j = -\alpha \sum_{i=1}^{m} \left(s_{ij} \ln s_{ij}\right)$	εj – measure of entropy of the indicator; coefficient $\alpha = 1/\ln m$; *sij* – standardized value of the indicator (indicator of sustainable development).

2.2. Calculation of the weighting factor of the sustainable development indicator.	$\bar{\delta}_j = (1-\varepsilon_j) \Big/ \sum_{i=1}^{n} (1-\varepsilon_j)$	δj – weight coefficient of the indicator of sustainable development; εj – measure of entropy of the indicator.
3. Assessment of the competitiveness of key enterprises in the region and identify their impact on sustainable development of the region		
3.1. Визначення конкурентної позиції компаній-двигунів розвитку території та побудова матриці формування конкурентної карти ринку	Балова експертна оцінка	
3.2. Оцінювання рівня конкурентоспроможності підприємств, розрахунок суми рангів експертів $\sum x_i$ та відхилення суми рангів x від середньої суми рангів	$\bar{B} = \left\| x - \bar{x} \right\|$	$\bar{B}$ – the sum of the ranks obtained by all options $\bar{x}$ – the arithmetic mean of the sum of ranks.
3.3. Calculation of the arithmetic mean of the sum of ranks	$\bar{x} = \frac{\bar{B}}{n}$	$\bar{B}$ – the sum of the ranks obtained by all options; n – number of indicators
3.4. Calculation of the sums of squared deviations of scores	$\bar{Q} = \left(x - \bar{x} \right)^2$	$\bar{Q}$ - the sums of squared deviations of scores
3.5. The checking the consistency of experts' opinions with the help of the concordance coefficient	$W = \frac{S \times 12}{m^2 \left(n^2 - n \right)'}$	S – the sum of the squares of the deviations, m – number of experts, n − the number of evaluated indicators.
4. Application of the TOPSIS model		
3.1. Construction of a matrix of weighted indicators of sustainable development.	Matrix elements: $\Delta ij = \delta j \bullet zij$	$i = 1, 2, \ldots, m$; $j = 1, 2, \ldots, n$; δj – weight coefficient of the indicator of sustainable development; zij – the value of the indicator (sustainable development indicator) for a specific object of study (territory or region).
3.2. Finding the best estimates of indicators Δ^+ (perfect positive solution PIS) and worse estimates Δ^- (perfect negative solution NIS).	$\Delta^+ = \max_j \Delta ij$ $\Delta^- = \min_j \Delta ij$	$i = 1, 2, \ldots, m$; $j = 1, 2, \ldots, n$; Δ^+ – perfect positive solution (PIS); Δ^- – perfect negative solution NIS (NIS).

3.3. Estimation of the distance between the value of the indicator evaluation and the best (perfect positive) value and the distance between the evaluation value and the worst (perfect negative) value	$S_i^- = \sqrt{\sum_{j=1}^{n} \left(\Delta ij - \Delta^- j\right)^2}$ $S_i^+ = \sqrt{\sum_{j=1}^{n} \left(\Delta ij - \Delta^- j\right)^2}$	S_i^+ – the distance between the values of the indicator (Δij) i the best (perfect positive) value Δ_j^+; S_i^- – the distance between the values of the indicator (Δij) i the worst (perfect negative) value Δ_j^- ; i = 1, 2, … , m.
3.4. Calculation of the relative level of sustainable development of a region or territory.	$Pi = \frac{S_i^-}{S_i^+ + S_i^-}$	Pi – relative level of sustainable development indicator; i = 1, 2, …, m.
3.5. Estimation of the final value of the aggregate indicator of sustainable development of a region or territory.	$P_i^{ST} = \sum_{i=1}^{n} P_{ij} \bullet \delta_j$	i = 1, 2, …, m – number of assessment objects (territory or region); j = 1, 2, …, n – the number of criteria for assessing sustainable development; Pi (ST) – aggregate indicator of sustainable development i–ї territory or region

(Source: improved of author's on the basis of Ghobadi and Heshmatpour, 2015; Wang and Lee, 2007; Filippova and Karpenko, 2016)

The main stages of application of the TOPSIS method in this methodological approach are the following: construction of an index system of monitoring, assessment and analysis of sustainable development of territories; application of the method of evaluation and the method of weighing indicators; assessment of the stability of calculations when changing certain parameters and assessment of structural changes in the territorial production system of the region under the influence of changes in economic relations, market processes, interregional and intersectoral relations. The TOPSIS model is able to objectively and comprehensively reflect the level of sustainable development of the territory, calculating the degree of closeness between the assessment (current) situation in the socio-economic system and its ideal state.

The general use of the TOPSIS model allows to solve the problem of estimating the final value of the aggregate indicator of sustainable development of a region or territory, taking into account the impact of the level of competitiveness of its key enterprises.

Conclusion

The article forms the author's approach to assessing the competitiveness of logistics infrastructure enterprises on the example of logistics and stevedoring companies of the Black Sea region. It was proposed to use this approach in the context of using the methodology for assessing the strategy of sustainable development of the region, as one of its stages.

The methodological approach to the assessment of sustainable development of the region based on the application of the TOPSIS model has been expanded by adding a methodology

for assessing the competitiveness of enterprises-engines of development of the territory, as one of the stages of the overall methodology. Within the framework of this approach, indicators for assessing the sustainable development of the territory or region are proposed and each stage of the methodology for assessing competitiveness, the results of which were presented in this study, is substantiated.

Conflict of interest

The authors declare no potential conflict of interest regarding the publication of this work. In addition, the ethical issues including plagiarism, informed consent, misconduct, data fabrication and, or falsification, double publication and, or submission, and redundancy have been completely witnessed by the authors.

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