Justification of the identification of threats and problematic components of sustainable regional development in the security dimension

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Abstract. The issue of substantiation of the problematic components of sustainable development in the security dimension and threat identification methodology is investigated. The methodology consists of directly combining the identification of threats with the need to observe the limits of the safe existence of dynamic economic systems, which connects the problem of sustainable development with the problem of security. The explanation of the extended homeostatic plateau, which explains the conditions for the transition to a higher technological system, or the complication of functioning and the loss of the main functions of the existing technological system, has gained further development. A theoretical substantiation of the limits of secure existence in terms of security gradations is proposed: critical, threshold, and optimal on both sides of the "extended homeostatic plateau". Quantitative values of security gradations are associated with the extension of the "t-criterion" method for the formal determination of bifurcation points for characteristic types of distribution, that is, threats. The identification, classification, and analysis of problematic components and critical threats at the level of components and indicators were carried out, which made it possible to identify only four strategic directions of institutional measures that allow covering almost all indicators of sustainable development at the regional level.

1 Introduction

The identification of threats to sustainable development as a component of the country's national security involves attributing to them phenomena, trends and factors that make it impossible or difficult to realize national interests and preserve national values. Meanwhile, any classification of threats can be considered conditional due to implementation on the

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basis of different grounds, pursue different goals, and therefore has a subjective nature. There is a well-known approach to identifying threats, which is based on the application of the concept of risk and allows you to operate precisely on the causes of undesirable system states [1-3]. The proposed approach consists in assessing national risks, comparing the relative impact of the specified threats determined by experts and the probability of their occurrence (relative likelihood), which is published every two years.

The main tool for determining risks and threats is a probabilistic expert assessment of the identification of uncertainties and randomness of environmental changes, natural phenomena, risks in sustainable construction projects, the implementation of circular economy methods, risk management, waste and utilization, analysis of trends in resource security, environmental stability and sustainable development [4-18].

Therefore, the analysis of modern research allows us to conclude about the need for comprehensive scientific study of various aspects of the definition of threats and problematic components of sustainable development in the security dimension. The development of a universal methodology for identifying threats, taking into account all components of sustainable development, will allow strategizing the national economy, including in conditions of uncertainty and force majeure conditions.

In the process of identifying the level of sustainable development in the security dimension, some of the indicators become critical threats that prevent the achievement of the level of sustainable development. Therefore, the scientific substantiation of the identification of threats and problematic components of sustainable development in order to further substantiate the priority directions of institutional measures to overcome them, which is *the purpose of the study*, becomes extremely urgent.

2 Material and Methods

To identify the current level of sustainable development of a country (region) or a type of economic activity, the concept of sustainable development in the security dimension is used "...as a management structure containing a general systemic view of the ways of transition from the current position of the management object to the desired one" [19]. The theoretical basis of the concept is applied systems theory, management theory and economic cybernetics and includes the stages of identification and strategizing, to which one more important component should be added: the identification of threats and problematic components of sustainable development for the scientific justification of institutional measures for the implementation of strategic scenarios.

2.1 Identification

Determining the structure of the security object, forming a system of indicators and choosing the form of the integral index is multiplicative and the weighting factors are dynamic, according to the methods of "principal components" and "sliding matrix" [19]:

$$I_t = \prod_{i=1}^{n} Z_{i,t}^{a_t}; \quad \sum_{i=1}^{n} a_i = 1; \quad a_i \geq 0, \tag{1}$$

where $z_{i,t}$ – the normalized values of the indicators; a_i – dynamic weighting coefficients.

The selection of the rationing method – combined:

$$S : z_{i,t} = x_{i,t} / k_{norm,i}; \quad D : z_{i,t} = (k_{norm,t} - x_{i,t}) / k_{norm,t}. \quad (2)$$

where $x_{i,t}$ – the current values of the indicators; $k_{norm,i}$ – normalization coefficient (for stimulants – the maximum value $x_{\max,i}$ from a sample of indicators and their limit values; for destimulant – $1{,}1\,x_{\max,i}$); *S* – stimulant; *D* – destimulant.

2.2 Determining the limits of save existence

Each dynamic system has its stable state of dynamic equilibrium and the process of reaching this state can be considered as the system's attempt to be within the limits of the "homeostatic plateau", which was first proposed by John P. Van Gigch [20] and included the plateau itself and the destruction of the system from both sides.

The concept of "homeostatic plateau" was improved in the work [21], which is distinguished by the addition of a range of threshold and critical values with a neutral and positive feedback region, staying in which is dangerous and leads to system transformation or even destruction (Fig. 1).

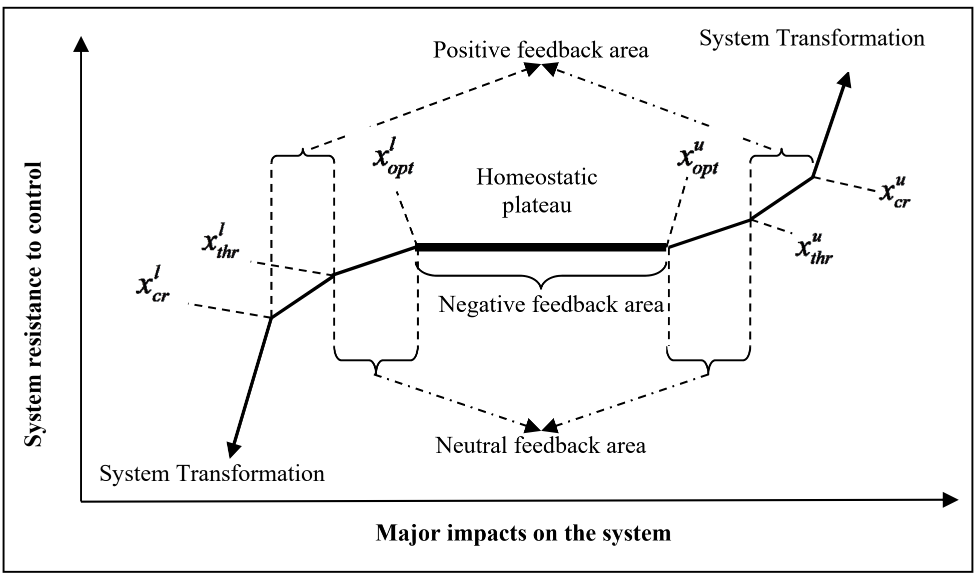

Fig. 1. Extended homeostatic plateau of the dynamical system [21].

The number of gradations of security (critical, threshold, optimal) on both sides of the homeostatic plateau is associated with the concept of an extended "homeostatic plateau" and spheres of positive, neutral and negative feedback" [21]. "The quantitative values of security gradations (bifurcation points) are associated with the extension of the "*t-criterion*" method through the construction of the probability density function, the determination of belonging to the type of distribution with the calculation of the statistical characteristics of the "exemplary" sample (mathematical expectation μ, mean square deviation σ and coefficient of asymmetry k_{as}) and formalized definition of bifurcation points for characteristic types of distribution (normal, lognormal, exponential)" (Table 1) [19].

Table 1. Formalized threshold vector values [19].

Type of Indicator Probability Density Function	Lower Threshold	Lower Optimal Value	Upper Optimal Value	Upper Threshold
Normal	$\mu - t \times \sigma$	$\mu - \sigma$	$\mu + \sigma$	$\mu + t \times \sigma$
Lognormal (tail right)	$\mu - t \times \sigma / k_{as}$	$\mu - \sigma / k_{as}$	$\mu + \sigma$	$\mu + t \times \sigma$
Lognormal (tail left)	$\mu - t \times \sigma$	$\mu - \sigma$	$\mu + \sigma / k_{as}$	$\mu + t \times \sigma / k_{as}$
Exponential (tail right)	$\mu - \sigma / k_{as}$	μ	$\mu + \sigma$	$\mu + t \times \sigma$
Exponential (tail left)	$\mu - t \times \sigma$	$\mu - \sigma$	μ	$\mu + \sigma / k_{as}$

To solve the task of automatic classification (recognition of images) of the distribution type of a random sample with predetermined standards based on digital data of the probability density function by artificial intelligence methods, a scientific approach has been developed, which consists in the application of cluster analysis, namely the discriminant method. Classification is carried out according to three criteria: Euclidean distance (quantitative feature) (3), Manhattan metric (quantitative feature) (4), Rogers-Tanimoto similarity measure - recognition by characteristic features (qualitative feature) [21].

Euclidean distance (quantitative feature):

$$d_k = \left[\sum_{i=1}^{N} (x_i - x_{ik})^2 \right]^{\frac{1}{2}}, \tag{3}$$

where N – number of points of "exemplary" sample ; k – number of clusters (types of distribution). Manhattan metric (quantitative feature):

$$d_k = \sum_{i=1}^{N} \left| x_i - x_{ik} \right| . \tag{4}$$

Rogers-Tanimoto similarity measure - recognition by characteristic features (qualitative feature):

- *normal type of distribution:*

a) clearly expressed maximum (not at the edges of the selection); b) the same number of points (± 1) with smaller ordinates to the left and right of the maximum point; c) the distance from the maximum point to the left and right is approximately the same to the extreme points ($\approx \pm 10 - 20\%$).

- *lognormal type of distribution*:

a) clearly expressed maximum (not at the edges of the selection); b) to the left (right) of the maximum point there should be at least 1-2 points with smaller ordinates; c) most of the points to the right (left) have a decreasing ordinate from the maximum; d) the distance from the maximum point to the extreme points is significantly different (> 2).

- *exponential type of distribution:*

a) clearly expressed maximum at the extreme left (right) point; b) a large point on the right (left) has a decreasing ordinate."

3 Theory

In contrast to [21], the explanation of the extended homeostatic plateau was further developed. If the current values of the indicators exceed the critical values to a greater or lesser extent, for technical systems this may lead to the destruction of the system [20], and for economic and social systems – to the transformation of the system, i.e. to qualitative (positive or negative) changes, as in objects of control, as well as in the control system. For example, it can be assumed that the existence of a certain "critical mass" of indicators (more than 50% of the number of national security indicators) exceeding the upper critical values may mean the future transition of the economic system to a higher technological order. On the contrary, approaching or exceeding the lower critical value - complication of functioning and loss of the main functions of the existing technological system.

Therefore, each indicator is characterized by a vector of limit values: lower and upper critical; lower and upper threshold; lower and upper optimal. Moreover, a pair of optimal values determines the homeostatic plateau, within which there are the best, that is, the most favorable, system functioning conditions and negative feedback. That is why the average between two optimal values (lower and upper optimal) - the middle of the "homeostatic plateau" - can be considered a criterion for achieving the level of sustainable development both for indicators and for component and integral indices [19]. Thus, a distinctive feature of the methodology for identifying the level of sustainable development is the integral assessment in the security dimension at the same time for indicators and their limit values, which involves the ratio of indicators, component and integral indices with the following gradations of security:

- optimal level - is limited to the lower and upper optimal values, within which there is a negative feedback and the best conditions for the functioning of the system, i.e. enhanced economic immunity - homeostasis - self-regulation, the ability of an open system to maintain the stability of its internal state with the help of coordinated reactions aimed at maintaining dynamic equilibrium under the influence of the environment; the task of managing the dynamic system is to keep the managed indicator within optimal values (homeostatic plateau);
- threshold level – limited to the lower threshold - lower optimal and upper threshold - upper optimal values, within which there is a neutral feedback, which means "conservation" of the management errors made, i.e. loss of the self-regulation function of the system; this means that the system cannot leave this state on its own, but slow control is required to enter the optimal level; the state of the system, the integral index or indicator of which is between the lower optimal and lower threshold values, as well as between the upper optimal and upper threshold values, can be characterized as crisis; at the same time, being in the upper threshold range is more preferable than in the lower range, because in order to return the system to the optimal zone in the first case, restrictions are implemented, and returning from the lower range to the optimal one requires slow control; this also applies to critical levels;
- critical level – is limited to the lower critical - lower threshold and upper critical - upper threshold values, within which there is positive feedback, which means an increase in the negative consequences of management errors and for the system to reach the threshold or optimal level, intensive control is required, even a change of the control system and control object. At the same time, the system enters a new state endowed with better quality characteristics; that is, in the process of development, not only the structure of the system, but also the interrelationships between the elements of the system and the mechanism of its functioning changes. Therefore, homeostasis in the economic system determines not only the ability to dynamic stability for the existing mode of operation, but also the ability to manage - the transition to a new state of economic equilibrium, that is, the controllability of the economic system.

Therefore, the lack of comparison of security indicators (integral indices) with integral limit values does not provide an opportunity to adequately identify the current level of safety.

4 Calculation

4.1 Identification of regional sustainable development in the security dimension

To identify the level of sustainable development, a structure is used with the following classic subsystems and corresponding components, which are described by 60 indicators [19]: *economic subsystem* - macroeconomic (structural, formal-informal), investment-financial, innovative, foreign economic; *social subsystem* - standard of living, demographic; *ecological subsystem* - ecological, tourist and recreational.

To determine the threats and problematic components of sustainable development at the regional level, the Kharkiv region was chosen as the region most affected by the military aggression (approximately -60% drops in gross regional product - GRP). For this purpose, predictive assessments of macro indicators and indicators for the end of 2021-2022 were made, and to determine the updated vector of limit values taking into account the military actions, as well as with the need for their periodic review, modern "exemplary" sample of indicators from economically developed countries and regions were formed. Applying the methodology and software described in subsection 2.2 [21], we will obtain, in contrast to previous publications [19]), complete vectors of limit values (including critical values) of all indicators of the postwar state (Tables 2-4).

Table 2. Full vectors of the limit values of indicators of the economic subsystem.

Components and indicators / thresholds	***Critical*** *low/up*	***Threshold*** *low/up*	***Optimal*** *low/up*	***2022***
Structural component				
- GRP per person, thousand UAH. / person (S);	212/2150	315/1725	460/1000	121,1
- specific weight of added value in agriculture to GRP, % (S);	3,75/18,5	4,3/15,2	6,3/10	11,43
- specific weight of added value in industry to GRP, % (S);	25/58	28/51,5	33/41	12,7
- specific weight of added value in the service sector to GRP, % (S);	33,5/100	41/93,5	52,5/74,3	38,11
- specific weight of employed in agriculture to total employment, % (S);	4,7/39	5,4/31,5	10,9/19,4	10,81
- specific weight of employed in industry to total employment, % (S);	13,7/42,7	17,6/39	23,8/32,6	15,37
- specific weight of employed in the service sector to total employment, % (S)	32/88	40/80,5	51/68,5	57,15
Formal and informal component				
- level of production technology (GRP share in output) (S);	0,35/0,72	0,383/0,66	0,44/0,55	0,44
- the level of shadowing of the economy, % of the official GRP (D);	34/2	28,5/4	20,5/10,7	34,08
- level of utilization of potential opportunities (S);	0,4/1	0,5/0,9	0,6/0,8	0,188
- coefficient of shadow loading of capital (D);	0,2/0,01	0,14/0,02	0,095/0,05	0,0342
- the level of shadow intermediate consumption, % to official (D);	30/2	23/3	14/6,5	37,07

Infrastructure component				
- transport capacity of GRP for railway transport, expressed in t-km/$, (D);	0,6/0,033	0,46/0,05	0,245/0,1	1,055
- transport capacity of GRP by road transport, expressed in t-km/$, (D);	1,1/0,15	0,94/0,245	0,69/0,4	0,378
- density of public railway tracks, 1/km (S);	47/74	48/68	52/59	52,78
- density of public roads, 1/km (S);	170/1130	193/920	293/562	309
- intensity of cargo transportation by road transport, t/km (S);	303/1430	333/1166	469/751	168,5
- intensity of passenger transportation by road transport, persons/km (S);	100/1308	260/1105	490/810	34,83
- intensity of passenger transportation by rail transport, persons/km (S);	0,7/3,8	0,95/3,2	1,47/2,2	0,273
- intensity of cargo transportation by rail transport, t/km (S);	3/25	5,5/22	9,5/16	1,366
Investment and financial component				
- investment level (the ratio of capital investment to output), % (S);	13/195	13,7/18,2	14,5/16	2,172
- share of growth of direct foreign investments (share capital) in relation to GRP,	3/40	5/35	11/25	0,209
%(S);	2,3/15	2,9/12	4,5/7,7	0,321
- the level of renewal of fixed assets, % (S).	6/38	9,7/32,4	15,2/24,2	15,45
- level of GRP redistribution through the consolidated budget (ratio of consolidated budget revenues to GRP), % (S);	26,5/0,5	22,4/1	15/6	7,918
- the level of transfers from the state budget, % to GRP, (D);	30/3	25/5	15/10	41,13
- the level of revenue losses of the consolidated budget due to shadowing, % to the official budget, (D);	15/1	12/2	10/4	25
- inflation (CPI), annual increase, % (D);				
Innovative component				
- the level of expenditures on scientific and technical works, % of output (S);	0,49/2	0,67/1,79	0,95/1,42	0,3354
- rate of scientific and technological progress, % per year (S);	0,1/7	0,2/5	0,5/2	-9,93
- level of funding of innovative activity, % of output (S);	0,11/5	0,275/3	1/2	0,0699
- specific weight of implemented innovative products in the total volume of implemented industrial products, % (S):	5/40	10/40	15/30	0,1524
- the level of inventive activity (the number of received protection documents - patents per 1 million people), (S);	66/795	66/675	250/490	692,3
Foreign economic component				
- export/import coverage ratio (S);	1,2/4	1,4/3,4	1,8/2,5	0,9514
- the level of innovative products in commodity exports, % (S);	10/60	15/50	18/35	0,5856
- level of export dependence, % to GRP (S);	30/90	36/80	48,5/70	23,28
- level of import dependence, % to GRP (D);	85/10	77/14	25/20	24,47
- share of import of goods in domestic consumption, % (D);	50/10	40/15	30/20	30,94

Table 3. Full vectors of limit values of social subsystem indicators.

Components and indicators / thresholds	***Critical*** *low/up*	***Threshold*** *low/up*	***Optimal*** *low/up*	***2022***
Standard of living				
- the level of labor utilization (the ratio of the optimal demand for labor to its supply) (S);	0,7/1	0,8/0,98	0,9/0,95	0,7224
- the level of remuneration in the issue (S);	0,15/0,382	0,2/0,35	0,26/0,32	0,1947
- the level of GRP created by shadow wages, % of GRP (D);	20/3	15/4	8/5	21,9
- the level of expenditure on education before graduation, % (S);	1/4	1,46/3,6	2,1/2,9	1,593
- the level of health care expenditures before graduation, % (S);	0,56/9,8	1,55/8	3/5,3	0,8384
- the ratio of the average wage to the living wage (S);	2/8	3/7	5/6	5,38
- specific weight of wages in the population income structure, % (S);	35/90	40/80	50/70	68,0
- the level of aggregate expenditure of households on food products, % (D);	60/10	56/18	30/20	65,0
Demographic component				
- life expectancy at birth, years (S);	58,4/88	76/83,6	78,4/81,2	65,0
- conditional coefficient of depopulation (D);	1,2/0,85	1,1/0,9	1,05/0,95	3,979
- general mortality rate, (D);	16/4	14,2/5,2	11/7,3	43,46
- infant mortality (D);	8/2	5,53/2,6	4,4/3,34	18,31
- total fertility rate (S);	7/15	8/14	10/12	10,92
- coefficient of demographic load % (D);	100/15	83/18,3	47/26,6	156,98

Table 4. Full vectors of limit values of environmental subsystem indicators.

Components and indicators / thresholds	***Critical*** *low/up*	***Threshold*** *low/up*	***Optimal*** *low/up*	***2022***
Ecology				
- the level of emissions of pollutants into the atmospheric air, kg/dollar. GRP (D);	0,0855/ 0,00071	0,0642/ 0,00276	0,0312/ 0,00922	0,0073
- level of use of fresh water per 1 person, m3 (D);	97/4	85,5/8,2	66/33,8	115,38
- level of volume of circulating and consecutively (re)used water per 1 person, m3 (S);	335/2860	564/2373	1000/1573	461,54
- the level of discharge of polluted return water into surface water bodies per 1 person, m3 (D);	3,94/0,62	3,3/0,83	2,2/1,45	3,85
- the reproduction level of loess, thousand hectares / million inhabitants (S);	0,0542/5,67	0,488/4,53	1,2/2,61	0,0769
- environmental investment level, % of output (S);	0,028/2,59	0,141/2,05	0,522/1,16	0,2795
Tourism and recreation				
- specific weight of the resort and recreation area in the total area of the region, % (S);	0,55/5,61	1,1/4,62	1,77/3	0,7285
- share of sanatorium-resort facilities up to 1000 population, (S);	1,5/11,9	2/9,7	3,5/6	1,6
- the share of cultural institutions for 1 mln. persons (S).	600/3033	622/2432	722/1440	615,38

By performing the identification of the current level of sustainable development of the Kharkiv region according to formulas (1-2) (normalization, weighting factors, integral convolution) simultaneously for the indicators and the vector of their limit values, we will obtain full vectors of integral limit values of the components of sustainable development (Table 5).

Table 5. Full vectors of marginal values of regional components of sustainable development.

Components of sustainable development / thresholds	***Critical*** *low/up*	***Threshold*** *low/up*	***Optimal*** *low/up*	***2022***
Structural	0,2171/0,9574	0,2675/0,8258	0,3811/0,5913	0,2577
Formal and informal	0,383/0,9769	0,5258/0,9259	0,6584/0,8166	0,4572
Infrastructural	0,2253/0,9074	0,2966/0,7947	0,4137/0,5973	0,1726
Investment and financial	0,2358/0,9319	0,3605/0,8487	0,4991/0,6891	0,2434
Innovative	0,1138/0,8895	0,1675/0,7541	0,3303/0,5634	0,0285
Foreign economic	0,2474/0,8628	0,3173/0,7626	0,4384/0,6209	0,1728
Standard of living	0,2880/0,9441	0,4007/0,8565	0,6067/0,7587	0,3419
Demographic	0,6111/0,9203	0,6839/0,8904	0,7695/0,8413	0,1761
Ecology	0,0884/0,9181	0,2109/0,8071	0,3791/0,5864	0,1574
Tourism and recreation	0,1276/0,9671	0,1823/0,7873	0,2737/0,4890	0,1484

4.2 Problematic components of sustainable development and indicators below or at the level of the lower critical value

Applying a scientific approach to identifying threats based on the criterion of deviation from the point of sustainable development for each component or indicator, we will obtain a list of components of sustainable development that deviate the most from the specified criterion and are: 1) at or below the lower critical value; 2) at the level between the lower threshold and lower critical values in the following order of critical importance (Table 6).

Table 6. Problematic components of sustainable development of the Kharkiv region.

Components below or at the level of the lower critical value	Components at the level between the lower threshold
Demographic	and the lower critical value
Innovative	Ecology
Foreign economic	Standard of living
Investment and financial	Formal-informal
Infrastructural	Tourism - recreation

Similarly, critical threats at the level of indicators of sustainable development are defined.

1. Demographic:

- the demographic load factor (D) is calculated by the ratio of the number of pensioners to the effective number of taxpayers, i.e., the factor of the pension demographic load. The improvement of this indicator is possible due to the increase in the number of employees through the creation of new jobs and the improvement of the standard of living;
- conditional coefficient of depopulation (D) - calculated by the ratio of the number of deaths to the number of births and is the most influential among all critical indicators on the level of sustainable development. One of the influential levers of increasing the birth rate is the increase in the standard of living of the population, the low level of which in the region clearly correlates with the increase in the depopulation ratio;
- the total mortality rate, (D) is calculated by the ratio of the number of deaths to the average annual number of the existing population. After the end of hostilities, the reduction in the death rate will depend on the standard of living;

- infant mortality (D) is a fundamentally important demographic and social indicator that reflects the general quality of life of the population, integrating the results of environmental, economic, educational, political, medical and other achievements or problems of the region.

2. Innovative:

- rate of scientific and technological progress (STP) (S) - equated with total factor productivity (TFP). STP is an internal factor in the development of the economy and is characterized by the organic influence of science and technology on the development of production and directly depends on the level of expenditures on scientific and technical, innovative activities and education of the population and, as a consequence, on the increase in budget revenues and GRP;

- specific weight of implemented innovative products in the total volume of implemented industrial products, (S) – is calculated by the ratio of the volumes of implemented innovative products to the total volume of implemented industrial products. Its increase depends entirely on the encouragement of scientists to create competitive innovative products, therefore, on the funding of science;

- the level of R&D expenditures (R&D), (S) – is calculated by the ratio of R&D expenditures to the output of goods and services as a percentage. Its increase depends entirely on budget revenues, and therefore on the increase in GRP;

- the level of financing of innovative activity, (S) is calculated by the ratio of the amount of expenditure on innovative activity to output. Its increase depends entirely on budget revenues, and therefore on the increase in GRP.

3. Foreign economic:

- the export-import coverage ratio (S) is calculated by the ratio of the volume of goods and services exported to the volume of goods and services imported. To improve the situation in this area of ensuring the economic security, it is necessary to take appropriate measures of import substitution and a significant increase in the export of products;

- the level of innovative products in commodity exports, (S) is determined by the ratio of the volume of innovative products from the total volume supplied for export to the volume of commodity exports. The low level of R&D funding, including at industrial enterprises, leads, in fact, to negative rates of scientific and technological progress and, as a result, to a decrease in the level of innovation. In turn, the low level of intellectualization of exports leads to the fixation of raw material export orientation on Ukraine and its regions;

- the level of export dependence, (S) is defined as the ratio of the value of exports to the value of the gross domestic product for the corresponding period. It depends both on the growing participation of the region in the international division of labor and on the growth of the competitiveness of the manufactured products.

4. Investment and financial:

- investment level (the ratio of capital investment to output), (S) – is calculated by the ratio of capital investment to output. The greatest effect of economic growth is given by an increase in investments, so they are a connecting element between aggregate demand and aggregate supply;

- the level of revenue losses of the consolidated budget due to shadowing, (D) – is determined by model calculations as the ratio of shadow budget revenues to budget revenues in the absence of a shadow economy, the reduction of which depends on measures to counter the shadowing of the economy;

- the level of renewal of fixed assets, (S) – calculated by the ratio of the volume of capital investments to the volume of fixed assets transferred to the GRP deflator, taking into account the disposal and renewal of fixed assets and depends on the increase in investments.

5. Infrastructure:

- transport capacity of GRP by rail transport, (D) – is calculated as the ratio of the sum of cargo and passenger traffic to the volume of GRP, i.e. in reduced billion t.km (sum of ton-kilometres and passenger-kilometres) to the volume of GRP. The indicator is a disincentive and a complex integrated indicator that depends on the state of the region's economy, the structure of industrial production, volumes of transportation and is the most important indicator of efficiency in the field of cargo and passenger transportation;

- the intensity of transportation of passengers and goods by road and rail transport, persons/km, t/km (S) - is determined by the ratio of the volume of transport work to the length of communication routes.

The analysis of the above critical indicators of economic recovery of the Kharkiv region allowed all of you four priority strategic directions of institutional measures, which can cover almost all indicators (60) of sustainable development of industrial regions of Ukraine:

1. Measures of deshadowing and anti-corruption activities.
2. Increasing the level and quality of life of the population.
3. Stimulation of innovative and scientific and technological activities.
4. Application of macroeconomic levers of economic growth: level of investment, import substitution, increase in exports and household consumption.

5 Conclusions

The methodology for identifying threats to sustainable development is proposed, which consists of directly combining the identification of threats with the need to observe the limits of the secure existence of dynamic economic systems, which connects the problem of sustainable development with the problem of security, namely with the identification stage. That is, determining the limits of secure existence is the most important stage of determining the level of security, which should be connected with the concept of dynamic stability of the economic system and its individual components or with the mechanism of homeostasis. A stochastic method is used to automatically determine the vector of limit values of indicators of sustainable development, which provides: automatic classification (pattern recognition) of the type of distribution of a random sample by predetermined standards based on digital data of the probability density function using artificial intelligence methods; automatic calculation of the vector of limit values by the "t-criterion" method for characteristic types of distribution: normal, lognormal, and exponential.

Threats to sustainable development were identified in the Kharkiv region using the method of imbalances (deviation from the point of sustainable development) to determine the list and importance of the impact. At the same time, critical threats are classified at the level of components and indicators that are below or at the level of the lower critical value. Detailed analysis of the description of critical indicators regarding their definition, levers of influence, and possible institutional measures This made it possible to identify only four strategic directions of institutional measures, which allow covering almost all indicators (60) of sustainable regional development: application of macroeconomic levers of economic growth: level of investment, import substitution, increase in exports, and household consumption; stimulation of innovative and scientific and technological activities; raising the level and quality of life of the population; measures of decentralization; and anti-corruption activities. Further research will be related to the application of macro-economic policy levers, tools for stimulating innovation and scientific and technological activity, measures to increase the level and quality of life of the working population, decentralization measures, and anti-corruption activities through the determination of their quantitative impact on macro indicators using model calculations and the formulation of recommendations for state authorities.

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