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## **SECURITY OF ECONOMIC POTENTIAL FOR CRITICAL INFRASTRUCTURE SUBJECTS**

*The article reveals the need to create the latest security and protection system of critical infrastructure in Ukraine and the first steps result on this difficult path. Incomplete identification problems of critical infrastructure subjects (hereinafter – CI) are summarized. Today, in international practice, CI is actively researched, as not only important system for the enterprise security, but as an integral state security system, therefore it is proposed to study the concept of «critical infrastructure» as a system of administrative and economic connections, that is normatively regulated at the state level, which includes objects (including tangible and intangible production enterprises), strategically important for both the development and security of the national economy and society as a whole. It is proposed to correlate the measures assessment to strengthen security with the generalized normalized assessment of the criticality level, that is used in Ukraine to identify the influence of risks of adverse external factors on CI subjects. On a sociological studies basis carried out in Rivne region territorial communities, the need for ranking communities in administrative management efficiency matters has been revealed, which will have a positive effect on both the social and economic development, as well as on strengthening their security. Based on sociological research results, SWOT-analysis of trends and factors of the territorial communities development, directions for the state policy improvement for supporting CI are substantiated, namely: comprehensive regulatory improvement and legal framework on the CI security, effective integrated system creation of state management of the such entities security; clarification of criteria for critical infrastructure identification; special reporting introduction on security indicators of the CI subjects economic potential; public and private partnership development, international cooperation in the field of safety CI ensuring, etc.*

**Keywords:** economic potential, security, critical infrastructure entities, territorial communities, administrative management.

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## **БЕЗПЕКА ЕКОНОМІЧНОГО ПОТЕНЦІАЛУ ДЛЯ СУБ'ЄКТІВ КРИТИЧНОЇ ІНФРАСТРУКТУРИ**



*У статті розкрито потребу в створенні в Україні новітньої системи безпеки та захисту критичної інфраструктури та результати перших кроків на цьому непростому шляху. Узагальнено проблеми неповної ідентифікації суб'єктів критично інфраструктури. Запропоновано оцінку заходів посилення безпеки корелювати з узагальненою нормованою оцінкою рівня критичності, яку використовують в Україні для ідентифікації ризиків впливу несприятливих зовнішніх факторів на суб'єктів критичної інфраструктури. На основі проведених в територіальних громадах Рівненської області соціологічних досліджень, розкрито потребу в проведенні рейтингування громад в питаннях ефективності адміністративного управління, що позитивно вплине на соціально – економічний розвиток громад, а також на зміцнення безпеки суб'єктів критичної інфраструктури.*

**Ключові слова:** економічний потенціал, безпека, суб'єкти критичної інфраструктури, територіальні громади, адміністративне управління.

## 1. Introduction

Whole world is watching Ukraine's experience in creating the latest security system and protecting critical infrastructure today. Cumulative direct losses from the destruction and damage of public sector objects (such as social objects and institutions, educational, scientific and health care institutions, cultural buildings, sports facilities, administrative buildings, etc.) amount to about 13.69 billion dollars.

According to the Community Development and Infrastructure Ministry of Ukraine, due to the Russian aggressor invasion, in the first year of the war alone, more than 25 thousand kilometers of state and local roads, 344 bridges were destroyed and damaged. The destruction of educational institutions, of which there are more than 3,100 (including almost 1,500 secondary education, 909 – preschool, 528 – higher education).

In general, during the first year of the war, aggregate assessment dynamics of direct losses of the Ukrainian economy increased from 54.5 billion dollars. from March, 2022 to 143.8 billion dollars until February, 2023 [1;2].

The largest share in direct losses total volume belongs to residential buildings (37.3%, or \$53.6 billion) and infrastructure (25.2%, or \$36.2 billion). Losses of business assets amount to 11.3 billion dollars. Direct losses of the agricultural sector to grow too, that estimated in the amount of 8.7 billion dollars.

Subjects of critical infrastructure were especially affected. Losses in the education sector increased by \$300 million (compared to December 2022) to \$8.9 billion as of the end of June 2023. In 2023, losses caused to the energy industry of Ukraine increased: its amount is 8.1 billion dollars. There was an increase in the estimate of losses in comparison with losses in nuclear energy, that previously caused: by 340 million dollars, medical infrastructure – by 100 million dollars.

In accordance with world practice, the main criterion for assigning objects, systems and networks to critical infrastructure (hereinafter – CI) is their extreme importance for the safe development of the country. Law of Ukraine No. 2684-IX «On Critical Infrastructure» (hereinafter – Law 2684-IX) regulates the critical infrastructure system as «...objects of critical infrastructure; systems, their parts, and their totality, which are important for both economy, national security and defense, the violation of which may harm vital national interests» (clause 13, article 1 of Law 2684-IX) [3]. The list of Ukrainian critical infrastructure entities (it is legally fixed, however, not final).

The state of war in Ukraine confirms the security system weakness of the CI, unfortunately, because:

- it is practically impossible to protect critical infrastructure objects from physical threats and cyber threats;
- current legal framework gaps are obvious, as a result of which modern effective communication between elements of such system has not been created nowadays;
- there is no unified state system of CI protection based on existing national systems of protection, security and crisis response, etc.

The concept of «critical infrastructure» needs to be clarified in relation to its subjects and objects at the legislative level. We offer clarification of the following categories, alternatively:

– CI objects – elements of the CI system: enterprises and organizations, regardless of ownership forms and business fields, that require systemic measures of operational activities security; assets with their security functions (primarily, state ownership); regulatory bodies, a system of communications at both state and public levels, aimed at the performance of joint functions regarding the preservation and support of balanced socio-economic national development;

– critical infrastructure subject (hereinafter – CI subject) – subjects of economic activity, which, according to their functional purpose, belong to critical infrastructure in accordance with the law.

Each CI subject can be subject to the destabilizing effect of the certain threats influence. It must be an object of security, on the one hand, on the other – a subject of security: having both the duty and right in order to implement security measures independently as an integral part of business; bear responsibility for their own inaction in countering internal and external threats within legislation limits.



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– critical infrastructure subject (hereinafter – CI subject) – subjects of economic activity, which, according to their functional purpose, belong to critical infrastructure in accordance with the law.

The subject of this study is economic activity, defined by legislation as objects of CI system. It is important to adhere to the approach comprehensively for assessing their functioning: from the point of view of vital functions performance view for such legal entities and their operational tasks.

Law 2684-IX regulates several approaches to security concepts for determining the resource provision for CI entities:

– critical infrastructure security – assessment of the sufficient security state of CI subjects, which ensures functionality, continuity of work, operational activity integrity and stability;

– critical infrastructure protection – administrative procedures and processes at all levels (entity, region, state) aimed at timely detection, prevention and neutralization of threats to the CI facilities security;

– formation and consistent implementation of state management policy in the critical infrastructure protection field [4].

## 2. Literature review

The concept of «critical infrastructure» is being actively modified today. The Law of Ukraine «About Basic Principles Cyber Security Ensuring of Ukraine» pursuant to No. 2470-IX (hereinafter – Law 2470-IX) refers to critical infrastructure objects such as enterprises, institutions and organizations (regardless of the form of ownership), which:

1) conduct activities and provide services in the fields of energy, chemical industry, transport, information and communication technologies, electronic communications, banking and financial sectors;

2) provide services in life support spheres for the population, in particular – in the spheres of centralized water supply, drainage, electricity and gas supply, food production, agriculture, health care;

3) are communal, emergency and rescue services, emergency assistance services to the population;

4) included in the list of strategic importance enterprises for the economy and security of the state;

5) are objects of potentially dangerous technologies and productions [5].

The EU Council Directive identifies CI objects as «assets, a system or a part of it, which are important for the functions maintenance of society, health, safety. Critical infrastructure damage, its destruction, violations as a result of natural disasters, terrorism, criminal activity, and malicious behavior can significantly affect the security of the EU and the well-being of citizens negatively» [6].

The Green Book on the Protection of Critical Infrastructure regulates the CI of Ukraine as a system and resources, physical or virtual, that provide functions and services, the violation of which will lead to serious negative consequences for the society life, socio-economic development of the country, ensuring national security [7].

It is obvious: the element range of the critical infrastructure system in international practice is wide enough, which should be taken into account at the stages of the CI formation as a complete system in the state.

Biryukov D.S., Kondratov S.I. note that «critical infrastructure usually includes transport and energy networks, systems of interbank settlements and telecommunications, as well as objects necessary for the functioning of state authorities, emergency response services and emergency assistance to the population, life support systems ...» [8].

Uryadnikova I.V., Zaplatynskiy V.M. substantiated the critical infrastructure general concept of CI in the following edition: «...physical and virtual systems, objects and resources, the destruction, destruction or reduction of the effectiveness for which will lead to significant threats to the country (region or city), its national security, livelihood and population health» [9].



The opinion of S.M. Chumachenko, A.S. Partalyan, A.O. Moshensky, M.L. Sukalo, L.D., Filatova is quite interesting. They note: «...when determining elements of CI, a hierarchy of criteria is built, covering the following main groups: economic security; life safety and population health; state security and defense; national economic development and self-support» [10].

In the given definitions, needs to strengthen security and economic functions of critical infrastructure objects (among which are CI entities), their regulatory subordination at the state level, clarification of the concept economic essence of «economic security», definition and substantiation of resource assessment for the rational provision of CI entities with production resources for the fulfillment statutory goals and tasks.

The military invasion of the russian terrorist country, integral support of our country at the world level makes it necessary to unify the term «economic security of critical infrastructure» taking into account both the international practice of its operation and functional role of CI system elements in order to resource needs determine objectively for preservation, full functioning and restoration of CI facilities.

In the study of Cornelia Scholz, Stefan Schauer, Martin Latzenhofer the quantity of descriptions per critical infrastructure dependency is analyzed and visualized and used to discuss the perception of how critical those infrastructures are. The study revealed that new infrastructures have been identified as critical in recent literature and that the focus was shifted to specific infrastructures that were in more pressing need during the pandemic [11]. Andrew Deelstra and David.N. Bristow discusses the importance of comprehensive, coordinated, and accessible emergency planning activities to ensure that the needs of all residents are considered [12]. João Henriques, Filipe Caldeira, Tiago Cruz, Paulo Simões proposed an Intrusion and Anomaly Detection System framework that adopts forensics and compliance auditing capabilities at its core to improve Critical Infrastructure Protection. Adopted forensics techniques help to address, for instance, post-incident analysis and investigation, while the support of continuous auditing processes simplifies compliance management and service quality assessment [13].

On the basis of the analysis carried out on the viewpoint of national interests' protection, we propose to study the «critical infrastructure» concept as a system of administrative and economic relations that is normatively regulated at the state level and includes objects (including subjects of tangible and intangible production). This system is strategically important for the development and security of the national economy, society as a whole, since damage, destruction, violation of the elements integrity for it can harm the economic independence of Ukraine.

The purpose of the study is to determine both theoretical and practical approaches to the formation and preservation of the security for CI subjects' economic activity (on the example of the legal capacity of such subjects in Ukraine).

The task of the research: to substantiate analytical procedures for assessing and preserving CI subjects' economic potential for the security of their balanced operational activities.

### 3. Material and Methods

Analysis of domestic legal acts regarding the critical infrastructure protection determines the relevance of making effective management decisions in order to improve its functioning, such as:

- entities belonging identification to the critical infrastructure system;
- levels regulation distribution for safety of subjects CI;
- economic risks methodology and assessment for CI subjects, their reflection in special reporting forms;
- internal Management Standards development regarding the prevention of crisis situations that are related to the CI entities functioning, leveling of their negative consequences [14];
- a state system creation for the formation, preservation and restoration of such subject's economic security;
- substantiation of unified approaches to safety indicator assessment of operational activity as an integral component for CI subject economic potential and so on.

The majority of scientists reveal the potential concept of the economic activity subject by using the available production resources, supplementing it with an image assessment, prospects of the subject's development [15]. However, it is inappropriate to focus attention when determining the economic potential security only on resources: it is important both for CI subjects to assess the availability of resources and their use efficiency.

In a broad sense, economic security is a complex of official state bodies effective measures that enable resistance to external and internal threats, characterize the national economy ability in the context of self-reproduction and satisfaction of expanded needs of citizens, society and the state [16]. The events in Ukraine confirm that the CI subject's economic security is related to the stability of their economic potential directly.

Regarding the safety assessment as an integral element of the CI subject management, the methodological recommendations regulating the generalized normalized assessment of the criticality level [17] (formula 1) may well be a normative reference point for this:





$$PK_{OKI} = \frac{\sum PK_i}{\sum PK_{max}}, \quad (1)$$

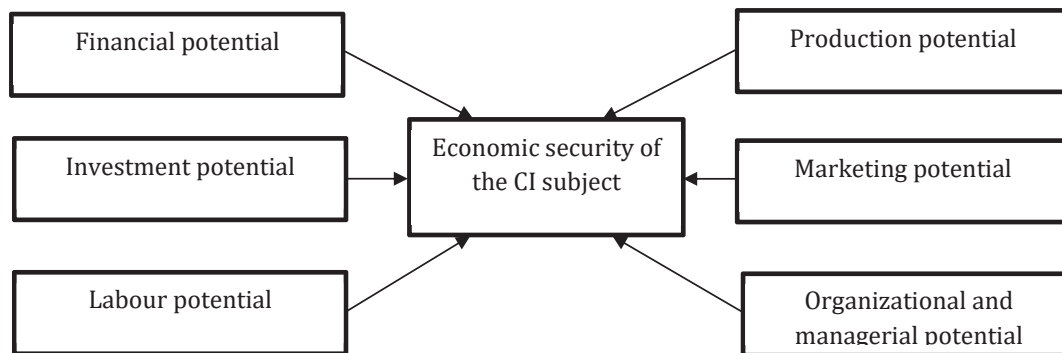
where  $PK_{OKI}$  – is a generalized normalized criticality level assessment of the CI subject (the range of which is determined by legislation);

$PK_i$  – the sum of points that is received by the CI subject for all criticality criteria;

$PK_{max}$  – the maximum possible sum of points (calculated based on the fact that the subject receives maximum points for all assessing criteria for the negative impact level).

In accordance with the Methodological Recommendations, the criticality determines the established level of financing the operational activities priorities for the CI entity, hence the providing normative indicators for such an entity with production resources.

The analytical indicators display of operational activity in the compliance with safety conditions context with safety conditions is also carried out in direct dependence on the generalized normalized assessment of the criticality level: with a higher level of criticality, attention to the analytical display in accounting and reporting (financial, special) of the external safety factors influence on the realization assessment of the economic potential of CI objects will be greater. It is important to comprehensively both evaluate and support the positive local community role in the safety formation.



**Figure 1. Resource components of subjects' economic security of the territorial community.**  
Built by authors

Source: [15; 26].

According to territorial-administrative reform results that were completed in Ukraine, the public management system of the economic activity organization in territorial communities has become more effective. As part of the reforms of local self-government and territorial organization of power in the Rivne region, a new administrative-territorial system was formed in the composition of 64 territorial communities and four consolidated districts (before the reform, there were 365 village, settlement and city councils in the region). All 64 territorial communities switched to direct relations with the State Budget from January 1, 2021, which made it possible to increase the attractive funding level for priority needs of communities [18].

The production potential (which is complex in structure and supplemented by other types of potential) gains functional weight as a priority in the conditions of martial law. Other forms of potential act as additional components in relation to production potential.

Financial potential determines a certain level of solvency, the degree of ensuring the CI subject competitiveness, the ability to effectively use and generate the subject's resources.

Investment potential is the CI entity ability to invest in its own development, creating an additional financial flow through investment projects.

Labor potential is the currently available and predicted future labor CI subject resources, characterized by the number of employees, their professional and educational level, indicators of personnel composition dynamics, etc.

Marketing potential is determined by the subject's influence on the consumers market, counterparties ready to continue and expand cooperation.

Organizational and managerial potential – the subject's ability to form an administrative procedures complex, their proper assessment in response to changes in the external environment, ensuring effective activity at all management levels [22].



Taking into account the indicators variability regarding assessment of the CI subjects security, the need for their prompt and strategic response to external socio-economic and political influences, it is appropriate to talk about the management accounting organization for economic security taking into account the international practice of its implementation:

- in terms of responsibility centers for cost resource indicators of components economic security provision of the CI subject;
- by evaluating the administration effectiveness of such activities by using financial and non-financial (natural, qualitative) indicators.

Both the internal operating environment and external territorial community (hereinafter – TC) infrastructure are important for CI subjects (figure 2).

In territorial communities of the Rivne region, the problem of providing managerial personnel remains unresolved: during the territorial administration changes not, all TC have qualified managerial support, unfortunately.

Among priority community cooperation directions are agreements preparation and implementation between territorial communities, in particular, on the following issues: energy saving, vacant lands development, provision of social rehabilitation support to military operations participants, development of socially oriented business, etc.

In order to determine the objective administrative and resource support of the TC, it is advisable to introduce the community rating (taking into account security issues of the CI subjects).

International practice includes the Human Development Index (hereinafter – HDI) in regional ratings successfully. The HDI combines three indicators: gross domestic product within the territorial community per capita, the literacy rate and the life expectancy of the community's residents. The indicator content is as follows: the closer the HDI is to one, the higher opportunities for the human potential realization due to the education level improvement, economic development and the health care system.

According to the methodology of the United Nations, HDI is calculated as the geometric mean of population income indices, average life expectancy and level of education (formula 2):

$$I_{hdi} = \sqrt[3]{(I_{in} + I_{ex} + I_{ed})} \quad (2)$$

where  $I_{in}$  – per capita income index;

$I_{ex}$  – average life expectancy index;

$I_{ed}$  – index of the education level of the population.

Ukraine rose by 14 positions in the Human Development Index in 2021, and at the beginning of 2022 took 74th place. A total of 189 countries are in this rating. Ukraine ranked 88th in last year's Human Development Index. The overall coefficient of Ukraine is 0.779 (out of a maximum of 1.000). According to the index, the life expectancy of Ukrainians is 72.1 years [21; 22]. The war had a negative impact on the HDI of Ukrainians.

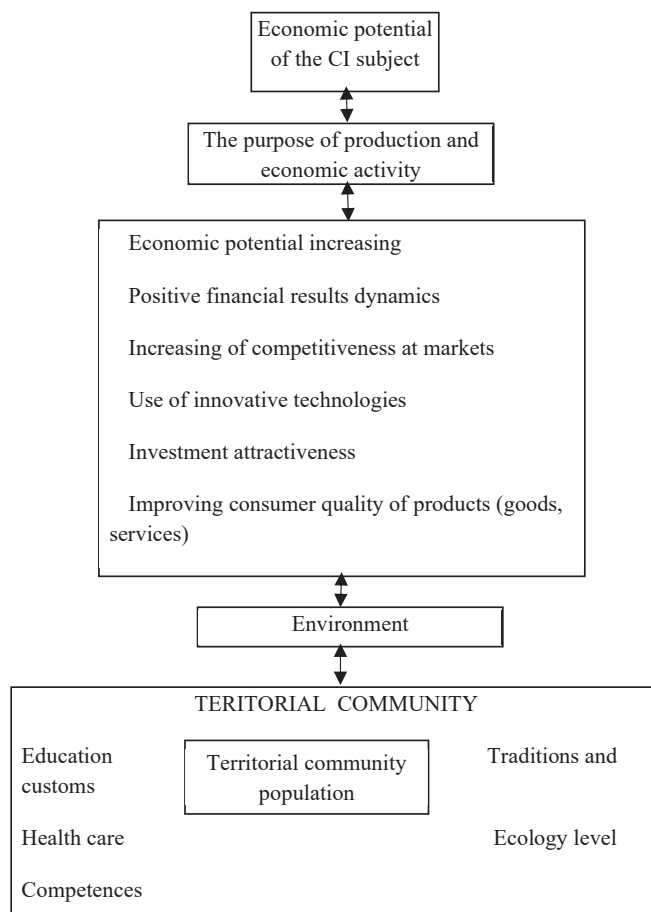
In order to establish system control over HDI dynamics, its component indicators should be recognized in unified forms of special/integrated TC reporting. Such a task is entrusted to regional state administrations. Nowadays, the development strategies of TC of the Rivne region have been approved and are operating in 25 territorial communities. At the same time, their lack of compliance with the regional development legislation is obvious in Ukraine, such as: requirements of Law No. 2389-XX [23], Methodological recommendations on the procedure for developing, approving, evaluating and implementing strategies for the territorial community's development according to No. 265 [24], etc.

Qualitative improvement is needed, such as:

- training and advanced training of territorial communities' managers, as well as specialists – analysts, consultants;
- active involvement of experts and public in international technical assistance programs for TC (in particular, cross-border cooperation);
- international practice implementation of territorial-administrative self-government, special specialized centers, creation of inter-municipal cooperation (for example, such centers operate in Norway), etc.

Methodological recommendations provide that the characterization of comparative advantages, challenges and risks of the prospective territorial community development is carried out on the basis of the starting local development conditions, determined by SWOT-analysis: effective systematic study means assessment of the resource potential of the community. The SWOT-analysis matrix is built according to vector analysis:

- 1) S – strengths: business strengths;
- 2) W – weaknesses: weaknesses;
- 3) O – opportunities: opportunities;
- 4) T – threats: threats.



**Figure 2. The economic potential of the CI subject: external and internal factors of influence**

Source: [15; 26].

The substantiation of both causes and identified deviations, consequences, connections and dynamics involves an assessment of the object’s strengths and weaknesses, its opportunities and threats, and the provision of recommendations regarding the optimal vector of its development.

It is worth noting that strengths and weaknesses of the analysis object refer to its internal environment, and the opportunities and threats refer to its external environment.

The clearly defined goals of the TC are integrated into the strategic management policy of the CI subject, providing both enterprise managers and local self-government bodies, community residents the prospect of direct participation in regional economy development processes. Detailed measures to achieve the defined goals contribute to all involved managers, employees, and the public improvement to the fulfillment of assigned tasks.

In July 2023 we conducted a sociological study on the prospective TC development assessment, strengthening its impact on security against potential threats. Respondents of this survey were TC ‘s managers directly (64 territorial communities). The respondents of the survey were directly heads/starosts of TGs (64 TGs). SWOT-analysis results are shown in table 1.

*Table 1*

**Matrix of SWOT-analysis of trends and factors for territorial community development**

Strengths	Opportunities	Threats
Availability of a diversified economy. A high proportion of the working population. Developed transport network: 1) railway; 2) motor vehicle. Provision of drinking water. Moderate environmental pollution.	– introduction of both innovative and ecologically oriented technologies; – support by local and regional authorities and self-government; – increasing consumer demand for ecologically safe products on both domestic and foreign markets; – preservation of existing and development of new sales markets; – receiving investments by ensuring	– increase in operating expenses for environmental component financing of activities; – environmental requirements strengthening, state intervention and control over all production processes links; – activity of key competitors (production of similar products with improved environmental characteristics, appearance of substitute goods on the market); – low purchasing power of the population;



<p>Training of professional personnel. Quality of administrative services provision. Satisfactory practice of medical care providing: 1) stationary; 2) outpatient. High external independent assessment indicators of knowledge. Development of tourist services. Public activity of the TC population.</p>	<p>compliance with both environmental and economic investors requirements; – creating a positive image, ensuring long-term development; – saving resources due to their efficient and rational use; – increasing the scale of production; – influx of young people from other regions; – participation in international aid programs; – active participation in the territorial community life at the place of actual registration of the enterprise.</p>	<p>– lack of production stocks of natural origin; – deterioration of the environment; – loss of consumer confidence; – inconsistent implementation of reforms; – population aging; – society stratification on the levels of material support; – continuation of martial law; – labor migration abroad of qualified personnel; – better working conditions of competing enterprises; – insufficient motivation of the staff, lack of interest in achieving the current and strategic goals of the TC development.</p>
<b>Weaknesses</b>	<b>Opportunities</b>	<b>Threats</b>
<p>High level of unemployment. Low level of income. A significant share of the shadow economy. Lack of street lighting. Lack of sewage networks Low share of capitalization costs. Inefficient waste management system. Low level of digitization of basic public servers. Lack of public spaces for public business activity. Low modernization of transport networks.</p>	<p>– introduction of the self-employment system; – implementation of educational projects for training, retraining and upgrading of employees qualifications; – increase in funding for capital expenditures; – introduction of the environmental management system; – separation of the Center of responsibility for environmental safety indicators; – development and implementation of human rights policy, anti-corruption policy, Code of Ethics.</p>	<p>– high credit rates; – freezing of the military conflict; – outflow of personnel outside the TC; – reforming the material incentives system; – organization of social and household infrastructure for employees.</p>

Compiled by the authors on the basis of sociological research: [20; 25, 26].

#### 4. Conclusions

The national security system formation of CI subjects is the duty, for the first, of the authorities. This issue is especially relevant in hybrid war conditions, when any Ukrainian can become the object of a terrorist threat.

According to the results of economic and legal framework studies for the critical infrastructure protection in Ukraine, it is advisable to propose the improvement of state policy in the following areas:

- 1) comprehensive improvement of the regulatory and legal framework on the security of CI system, creation of an effective integrated system of security state management for such entities;
- 2) development of identification criteria for CI objects, their passports;
- 3) development of standardized administrative steps and procedures for: increasing the CI subjects protection level, special reporting forms unification and safety indicators of their economic potential;
- 4) strengthening of state support and protection of critical infrastructure facilities;
- 5) development of public-private partnership, international cooperation in the field of CIs security and emergency situations prevention, etc.

Based on the interpretation of the essence and main approaches to the security of the economic potential formation, the analysis of various approaches to distinguishing the security as economic potential components of the CI subject, it is proposed to consider the security of the economic potential in the context of both programs and strategies for territorial communities development of (where such subjects function), investigating the dynamics of operational and strategic socio-economic regional changes as influencing factors and the security of the economic potential of the CI subject.

It makes it possible to rationally and objectively form the security toolkit of its economic potential in the management system of CI subjects.

Taking into account conducted research results, a refined definition for the concept of «economic potential of a CI subject» is proposed, which takes into account key properties of this definition, the dependence of the economic potential for such subjects on economic resources, connections and reserves. Critical infrastructure is considered not just as an identified set of primary protection and control objects on the part of the state, but as a system of administrative-economic relations, normatively regulated at the state level, which includes objects (including subjects of tangible and intangible production) , important strategically for the national economy development





and security, society as a whole, since damage, destruction, violation of the integrity of such a system elements can harm the economic independence of Ukraine.

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