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## PROBLEMS AND PROSPECTS OF STRATEGIC MANAGEMENT OF CRITICAL INFRASTRUCTURE ENTERPRISES IN WARTIME CONDITIONS

### Abstract

The study identifies specific features of strategic management of critical infrastructure entities, in the mechanism of which in the realities of wartime the dominant vector is not the extensive increase in financial indicators, but ensuring systemic survivability through capacity reservation, duplication of key nodes and fortification of logistics channels. The need for deep convergence of corporate strategies with state, defense and transnational security priorities is emphasized.

It is established that the modern architecture of critical infrastructure enterprise management requires a radical digital transformation, in particular the implementation of cloud ecosystems and artificial intelligence algorithms for predictive analytics. It is substantiated that strategic planning goes beyond purely economic categories, integrating the development of communication networks, the design of evacuation protocols and mechanisms of social patronage of the population. The effectiveness of implementing such strategies in martial law conditions is determined by managerial flexibility and the ability to instantly reprioritize tasks against the backdrop of resource shortages and large-scale destruction of assets. The key management decision is the transition to intelligent monitoring systems capable of automatically verifying threats. Currently, the demand for the formation of multi-vector long-term strategies based on digital maturity, innovative activity and strengthening financial sovereignty is being actualized. The proposed comprehensive approach to strategic management of critical infrastructure enterprises will minimize the economic vulnerability of businesses and guarantee the uninterrupted functioning of vital systems in critical wartime conditions.

**Keywords:** strategic management, critical infrastructure, wartime, crisis management, financial stability, risks, risk management, economic security, post-war economic recovery.

**JEL Classification:** H56, L98, M21

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# ПРОБЛЕМИ ТА ПЕРСПЕКТИВИ СТРАТЕГІЧНОГО УПРАВЛІННЯ ПІДПРИЄМСТВАМИ КРИТИЧНОЇ ІНФРАСТРУКТУРИ В УМОВАХ ВІЙСЬКОВОГО ЧАСУ


## Анотація

У дослідженні ідентифіковано специфічні риси стратегічного менеджменту суб'єктів критичної інфраструктури, у механізмі якого у реаліях воєнного часу домінуючим вектором стає не екстенсивне нарощування фінансових показників, а забезпечення системної живучості через резервування потужностей, дублювання ключових вузлів та фортифікацію логістичних каналів. Зроблено наголос на необхідності глибокої конвергенції корпоративних стратегій із державними, оборонними та транснаціональними безпековими пріоритетами.

Встановлено, що сучасна архітектура управління підприємствами критичної інфраструктури потребує докорінної цифрової трансформації, зокрема впровадження хмарних екосистем та алгоритмів штучного інтелекту для предиктивної аналітики. Обґрунтовано, що стратегічне планування виходить за межі суто економічних категорій, інтегруючи у себе розбудову комунікаційних мереж, проектування евакуаційних протоколів та механізми соціального патронажу населення. Ефективність реалізації таких стратегій в умовах воєнного стану детермінується управлінською гнучкістю та здатністю до миттєвої репріоритизації завдань на тлі дефіциту ресурсів і масштабної деструкції активів. Ключовим управлінським рішенням визначено перехід до інтелектуальних систем моніторингу, здатних в автоматичному режимі верифікувати загрози. Натепер актуалізується запит на формування багатовекторних довгострокових стратегій, що базуються на цифровій зрілості, інноваційній активності та посиленні фінансового суверенітету. Запропонований комплексний підхід до стратегічного управління підприємствами критичної інфраструктури дозволить мінімізувати економічну вразливість бізнесу та гарантувати безперебійне функціонування життєво важливих систем у критичних умовах воєнного часу.

**Ключові слова:** стратегічне управління, критична інфраструктура, воєнний час, антикризовий менеджмент, фінансова стійкість, ризики, управління ризиками, економічна безпека, післявоєнне економічне відновлення.

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## Introduction

Wartime has turned critical infrastructure enterprises (energy, communications, transport, water supply) into the primary targets of the aggressor during air and ground attacks. Managing them in the realities of wartime requires not only anti-crisis, but also unique management strategies that were not provided for by classical models of organizational management. Currently, Ukraine is in the process of implementing laws on critical infrastructure, adapting its legislation to the standards of the European Union. In such circumstances, scientific research is necessary to substantiate management mechanisms in this new legal framework, especially in terms of the delimitation of responsibility between the state and the private sector regarding the distribution and use of resources critical to the economy and national security. It is worth mentioning that existing enterprise management strategies were developed in peacetime. Therefore, the relevance of the topic chosen for the qualification work lies in the formation of a new paradigm of strategizing - from business development planning to managing economic viability and rapid restoration of entrepreneurial activity. Successful strategic management of critical infrastructure is a key prerequisite for attracting international investment in the restoration of the national economic system. Scientific and applied recommendations should be aimed at creating transparent, sustainable and minimized risk management models that will convince partners of the reliability of Ukrainian assets. And the foundation for such proposals should be effective management mechanisms aimed at achieving long-term competitive advantages for businesses.

## Literature review

Management of critical infrastructure enterprises in wartime is characterized by specific features and manifestations that Ukrainian scientists describe in their research. It is on the publications of domestic researchers that the theoretical basis of this qualification work should be built, because the events of recent years in Ukraine, a full-scale invasion, war, blackouts and constant interruptions of production processes due to air raids have allowed us to deeply and comprehensively study and trace in practice the peculiarities of the functioning of the state's critical infrastructure in the realities of wartime. Thus, Boyko (2024) studies public policy and public administration in the field of critical infrastructure protection, Ivanytska, & Voznenko (2024) monitor the risk management of critical infrastructure facilities, Magomedov (2024) describes innovations in public administration in the field of critical infrastructure, and also formalizes the mechanism of public administration of the development of critical infrastructure facilities in the legislative, organizational and managerial dimensions, highlighting organizational and managerial challenges and opportunities for strategic management of the transformation of critical infrastructure facilities, Pomaza-Ponomarenko, & Taraduda (2024, 2025) summarize the principles of construction of critical infrastructure facilities and the features of their management and propose management approaches to the prevention of emergencies at critical infrastructure facilities and increased danger, Portna, & Magdysyuk (2025) raise the issue of information support for critical infrastructure management at the regional level, Rodchenko, & Rekun (2025) describe the current state of asset management at critical infrastructure facilities in regions in the context of traditional and innovative threats, Sydorenko, & Polozhenetsev (2024) propose an author's method for managing IT threats at critical information infrastructure facilities, Fedyk, & Denysenko (2024) consider theoretical and methodological approaches to managing cybersecurity risks at critical infrastructure facilities from the perspective of responding to cyber incidents and managing crisis situations, Shevchenko (2025) complements the mechanisms of public administration in protecting critical infrastructure facilities in the context of military aggression, Yaremenko, & Strahnitsky (2022) propose updated theoretical approaches to defining critical infrastructure as an object of public administration.

## Aims and Objectives

The purpose of the study is to identify the features of strategic management of critical infrastructure enterprises in wartime conditions. The objectives of the study were: to identify problematic aspects of managing critical infrastructure enterprises in wartime realities; to specify the concept of strategic management in the theory of management science; to identify the features of strategic management of critical infrastructure enterprises in Ukraine; to identify options and opportunities for taking into account wartime risks and digitalization opportunities in the strategies of critical infrastructure enterprises.

## Methods

Achieving the set goal necessitated the use of such scientific research methods as theoretical justification and conceptualization, which allowed the formation of a conceptual apparatus and theoretical basis for the work. System analysis was used to define critical infrastructure as a complex, interconnected and high-risk system, as well as to identify elements of the management system and the relationships between them. The analysis was used to process existing Ukrainian and international regulatory legal acts, scientific works, standards on critical infrastructure management and military threats. Synthesis allowed the formulation of author's definitions of existing concepts. Induction was used to derive general principles of anti-crisis management of critical infrastructure based on the analysis of the experience of individual enterprises (case method). Deduction was used to identify opportunities for applying generally recognized management theories to the realities of wartime.

## Results

Yaremenko & Strahnitsky (2022) define critical infrastructure as a plurality of functionally related elements of the national infrastructure or their parts located within the territory of the country in the form of physical, organizational information and communication structures (regardless of the form of ownership), technologies, assets, means, systems, networks, supplies, processes and specialists who manage them, which are crucial for the state to provide vital functions for society (health, security, socio-economic well-being of citizens, ensuring the sovereignty and sustainable development of the country) disruption of the functioning, destruction, failure or dysfunction in the work of which will have a critical impact on the ability of the authorities to provide these functions and may cause human casualties, significant material and environmental damage, other dramatic consequences and lead to a significant violation of national security and defense.

Based on the analyzed publications, we can conclude that the problematic aspects of managing critical infrastructure enterprises in wartime realities primarily lie in the need for management to simultaneously counteract physical destruction caused by missile strikes, artillery, cyberattacks and sabotage (internal or external). Traditional risk management in such realities turns out to be insufficient for the effective operation of the enterprise. Strategic decisions regarding the decentralization of production capacities, duplication of systems and construction of protective structures (equipment encapsulation) require huge investments and engineering solutions, which must be initiated at the strategic management level. Visible and tangible for Ukrainian enterprises are the problems with ensuring critical supplies (fuel, reagents, spare parts) due to disruption of supply chains, mine danger and the threat of attacks on transport infrastructure.

Given that critical infrastructure enterprises must operate at any cost, regardless of economic feasibility, they incur enormous uncompensated losses (for example, due to destruction, preferential tariffs for the population). Therefore, there is an urgent need for billions of investments for operational restoration, which is practically impossible for Ukrainian enterprises to cover at the expense of their own or internal financial resources. Therefore, the strategic management of critical infrastructure enterprises should be focused on attracting international financial assistance and grants.

The problem of documenting and assessing the damage caused for their subsequent compensation, as well as the inability to adequately reflect assets on the balance sheet in conditions of constant shelling, is also a management challenge for Ukrainian enterprises.

Despite the almost four-year duration of the war, the need for continuous work of critical infrastructure

enterprise personnel under shelling remains palpable, which requires unique programs of psychological support, security and motivation (especially for key operational personnel). In addition, there is a constant outflow of highly qualified specialists (mobilization, relocation abroad). Strategic management in wartime realities must solve the problem of quickly replacing critical positions and training personnel to cover personnel needs.

Thus, the management structure of enterprises, often designed for peacetime, turns out to be too inert and unable to quickly make vital decisions. A hybrid, flexible organizational model is needed, especially in the strategic personnel management of critical business entities.

Fig. 1 summarizes the problematic aspects of managing critical infrastructure (CI) enterprises in wartime realities.



**Figure 1. Problematic aspects of managing critical infrastructure (CI) enterprises in wartime realities**

Source: authors' development

Analyzing the opinions of modern scientists, we can summarize the main feature of critical infrastructure facilities - their belonging to the national infrastructure, which is an interconnected system of public administration and infrastructure facilities that ensure the activities of various spheres of the functioning of the state, its economy and society (Yaremenko & Strahnitsky, 2022).

Modern scientists share concerns about the inability of modern management personnel of critical infrastructure facilities to respond to the challenges of digitalization in the strategic management plane.

Problematic aspects of managing critical infrastructure enterprises in wartime realities are diverse and lie in the areas of financial, personnel, and operational management. However, the most tangible are the problems in strategic management, since it is on the long-term management horizon that the most relevant and resonant financial and economic risks and threats can be effectively identified and resolved.

Building effective strategies for the functioning and development of modern Ukrainian critical infrastructure facilities should begin with the management staff of such enterprises understanding the features of strategic management in theory. The economic vision of business operations in the conditions of uncertainty that has developed in our country should cover various areas of management activity, however, focus on long-term opportunities and prospects.

In the theoretical plane, strategic management can be defined by such target guidelines as achieving the stability of the competitive positions of the business, guaranteeing its sustainability in the process of achieving long-term economic, social, production and other results, forming the correct reaction of the personnel of the business entity to changes and manifestations of risks in the external and internal environments of its functioning.

The definition of strategic management is expressed by modern researchers as a method of managerial thinking that guarantees the achievement of long-term economic goals and goals of sustainable development of the enterprise and focuses the attention of management personnel on the importance of motivational influence on the behavior of employees by comprehensively taking into account their interests and needs to ensure the sustainable interest of the latter in the achievement of the company's strategic goals.

Strategic management of the enterprise is implemented according to the traditional scheme in five consecutive stages. At the first stage, goals are set, the characteristics of which should be attainability, realism and focus on a specific result. The stage of setting goals and ranking them allows you to identify which goal the enterprise should achieve first of all, given its limited resources. At the second stage, management specialists analyze the current state of the enterprise, determine its financial indicators, on the basis of which assumptions are made about what financial results can be achieved under the condition of various scenarios of the impact of existing and future risks on the business. At the third stage, the business strategy is formalized, which is a document in paper or digital form, which clearly specifies the strategic guidelines of the enterprise and the ways in which it should move to achieve them. At the fourth stage, the developed and agreed strategy is implemented in all, without exception, managerial and financial and economic processes of the enterprise: all of them must be subordinated to its strategic guidelines in order to function as a single comprehensive system aimed at achieving the desired economic result. And at the fifth, final stage of strategic management, the company's management must assess the level of strategy achievement and conduct control measures to identify deviations and reasons that hinder the achievement of the desired business development goals.

So, strategic management is a comprehensive system of management actions aimed at forming, implementing and evaluating the enterprise's strategy to achieve its long-term goals, ensuring sustainable competitive advantage and effective adaptation to a changing external environment.

Strategic management is not just planning the future state of the enterprise in accordance with the expectations of stakeholders. In an arbitrary interpretation, it is the art and science of seeing where the enterprise is moving (strategy), being able to react quickly when the world around it is collapsing (adaptation), and using all available resources to get to the planned point of movement and stay there (sustainable advantage).

Let us provide an explanation of the terminology that was used to define strategic management. We understand strategic management as a process, that is, as a continuous cyclical activity that includes such a set of management activities as strategic analysis, selection, implementation and control. Long-termism in the system of strategic management of an enterprise means that the focus of the management efforts of the company's personnel is on its future state, and includes determining the general course of economic development, and not the implementation of daily routine operations.

Adaptability (in wartime - resilience) is used to describe the strategic management process in order to emphasize at the theoretical and applied level the ability of company management personnel to quickly review strategic decisions and adjust the course in response to unforeseen threats and changes (military, economic, political). The concept of sustainable competitive advantage meaningfully encompasses what distinguishes an enterprise from competitors and allows it to generate value while being on the market and in the national economic system for a long time.

For enterprises of different types of economic activity, strategic management has its own characteristics, since the goals and long-term visions of business development in different areas differ significantly. In the context of considering critical infrastructure enterprises during war, the emphasis of strategic management shifts from "competitive advantage" to "advantage in survival and survivability", which means the need to

review and modernize existing strictly critical for the national security of Ukraine enterprises.

## Discussion

We propose to understand the strategic management of a critical infrastructure facility as a proactive, continuous, dynamic process of forming, implementing and monitoring the consequences of management decisions aimed at ensuring “survival”, business resilience, continuity of operation and sustainable and high-quality provision of various types of critical services in conditions of increased threats and uncertainty (especially in the realities of wartime).

An important stage of strategic management of an enterprise is planning its future indicators in various areas of financial and economic activity. The realities of wartime create an atmosphere for the impossibility of long-term strategic planning (for 5 or more years). Therefore, the current strategies of critical infrastructure enterprises are reduced to “planning for an unpredictable” future state in short cycles (for six months - a year), with a focus on the flexibility of changing strategic guidelines.

Recalling the problems with the implementation of digital technologies at critical infrastructure enterprises, which are explained by the bureaucratization of management processes at such facilities, Existing digital systems may be vulnerable or incompatible, and may not have a positive effect on the activities of the business entity. In such conditions, the enterprise strategy should ensure the implementation of secure, cloud-based business solutions for management and control using the capabilities of artificial intelligence, which requires a significant transformation of the overall management structure.

Critical infrastructure enterprises are closely dependent on the decisions of government agencies. Therefore, most of the management decisions of such companies must be consistent with the vision of representatives of the public administration and administration regarding the promising directions of their further development. In view of this, a management problem arises of integrating the efforts of all entities and all stakeholders when developing strategies: private owners, employees, local authorities and central authorities. Effective strategic management in this context should contribute to the creation of a single operational and communication platform and the exchange of information about environmental threats and risks.

Modern researchers propose to build a management strategy for Ukrainian enterprises that belong to critical infrastructure facilities, taking into account the need to ensure their economic security (Zachosova, et al., 2023). At the same time, it is also not worth neglecting the aspects of managing the effectiveness of domestic business organizations in wartime and martial law, as convincingly demonstrated by Harafonova et al., (2022), Yepifanova et al., (2023). Given such proposals and recommendations, there is a need to change the paradigms of strategic management of enterprises in crisis conditions of wartime.

The problems that Ukrainian enterprises face during the strategic planning of the vectors of their prospective activities are:

- limited material and human resources, lack of sources of their replenishment, which is associated with active hostilities in parts of the territory of Ukraine;
- scaling of destruction of the material base and logistics structure used for conducting business activities;
- decreasing number of clients and consumers of companies' services;
- increasing level of competition in industries accessible to external suppliers and participants who are physically registered and operating in countries of the world for which the risks of war are currently still illusory and look unrealistic.

Management responses to such conditions of doing business at the strategic level should be:

- flexible strategies that do not require long-term review and coordination, but can be changed in accordance with the manifestations of new conditions and risks;
- active introduction of digital technologies and digitalization of business processes in order to minimize the risk of physical destruction of the main resources of companies and the creation of digital twins of enterprises, institutions and organizations;
- active expansion of the boundaries of remote employment to protect the personnel of enterprises and preserve the lives and health of employees during enemy attacks;

- environmentally responsible development and application of innovative technologies to ensure uninterrupted supply of electricity to the facilities of economic structures;
- search for opportunities for business relocation and its development in new local areas in the interests of united territorial communities;
- diversification of services, including through the introduction of digital services.

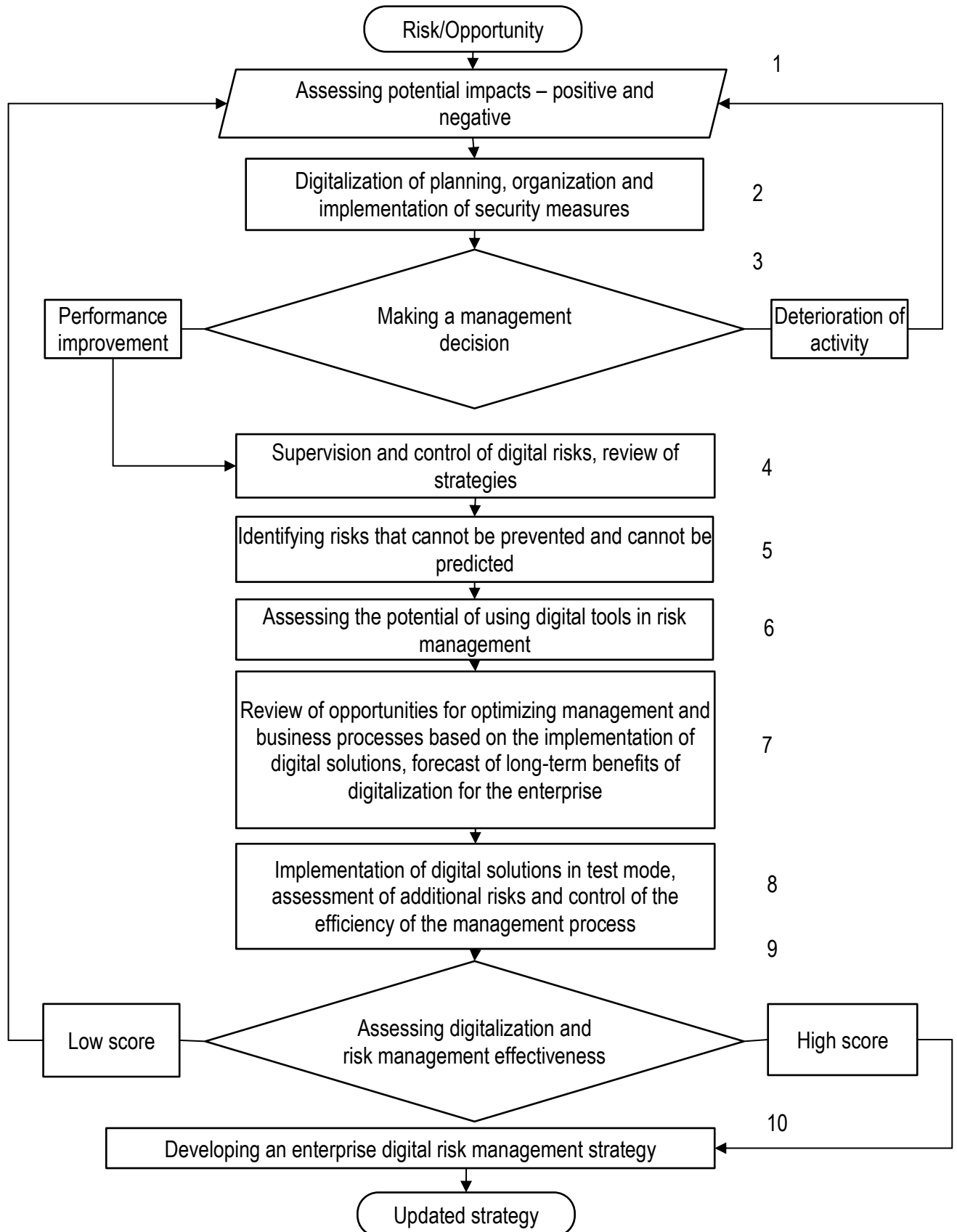
Strategic guidelines, which will be based on the listed business development opportunities, have a chance to guarantee economic survival and financial stability to Ukrainian enterprises even in conditions of intensification of wartime risks (Nosan, & Bazunov, 2025).

Fig. 2 formalizes a step-by-step approach to taking into account wartime risks and digitalization opportunities in the strategies of critical infrastructure enterprises. The proposed algorithm is proposed to be used by the management of enterprises strategically important for national security and the economy when developing various alternatives for the restoration or development of their activities, which may be intensified or restrained by factors of the external and internal environment for companies. Such an approach makes it possible to maximize the positive effects of digital transformations and minimize the negative consequences of military threats for the vital activity and resilience of critical infrastructure facilities.

The most tangible risks that can have the maximum negative impact on the activities of enterprises and their financial results remain war and the introduction of martial law. These types of risks can include such threats as physical attacks on critical infrastructure facilities, mobilization of highly qualified specialists, disruption of transport links and delays in raw materials and materials. The management response to such risks can be the effective integration of company management with military and state structures, which will make them objects of the implementation of the “supranational” mission of population survival and maintaining viability within the state. On the other hand, excessive state regulation and control are also risks with potential critical consequences. However, for critical infrastructure enterprises, state supervision and control play a positive rather than a negative role in their activities, as they mean priority in the allocation of financial resources and assistance in the supply of raw materials. The management decision during interaction with state authorities on the part of the management of critical infrastructure enterprises should be an active communication policy, which will allow to guarantee timely compensation of financial losses and support of a stable tariff policy for companies providing services to the population.

Ukraine's loss of human capital also meant a decrease in the number of clients for critical infrastructure enterprises. Business relocation has also significantly changed the spheres of influence of regional enterprises on the national markets of goods and services. In such conditions, the management decision should be to adapt to new realities, diversify services, improve their quality, accessibility and form the ability to provide remote service in those niches where this is possible. Customer-oriented policies and high-quality service will allow to retain consumers and ensure a high level of their loyalty in order to prepare for possible service interruptions or price increases for services.

The psychological state of personnel and professional burnout caused by working in conditions of constant stress and military risks are also a problem of critical infrastructure enterprises, which requires management decisions from the management of companies. Efforts to ensure the maximum level of physical safety of employees at their workplaces should be clearly traced, as well as actions to update the personnel policies of enterprises, primarily in terms of expanding the boundaries of motivational measures regarding digital risks. The possibility of using digital technologies, such as artificial intelligence and cloud solutions, to increase the level of management efficiency, monitor the activities of enterprises and diagnose equipment, is combined with cyber threats and the likelihood of data loss. In view of this, the optimal management solution will be the development and implementation of a digital transformation strategy, as well as digital risk management, which will generally be focused on the security and high level of security of cloud solutions and on increasing the operational efficiency of business functioning in the digital ecosystem.



**Figure 2. An approach to considering wartime risks and digitalization opportunities in the strategies of critical infrastructure enterprises**

Source: authors' development

## Conclusions

1. Management of critical infrastructure enterprises in wartime conditions is becoming exceptionally relevant and demonstrates a radical change in the management paradigm – from commercial efficiency to national resilience. The main problematic aspects of managing critical infrastructure enterprises in wartime realities are multifaceted and lie, first of all, in the plane of strategic management. Traditional risk management is ineffective, since management is forced to simultaneously counteract physical destruction (missile strikes), cyberattacks and sabotage. The need for uninterrupted operation “at any cost” leads to uncompensated losses and an urgent need for billions of investments for operational restoration. The strategic focus should be directed at attracting international financial assistance and effective documentation of losses. The inertia of management structures, the critical outflow of qualified personnel through mobilization and relocation, as well as the need for unique psychological support for personnel require an immediate transformation of the organizational model into a flexible (adaptive) one.
2. For critical infrastructure enterprises during war, a situation is characteristic when strategic priorities undergo a radical transformation: the emphasis shifts from the classic “competitive advantage” to “survival and resilience advantage”. In this context, a relevant management solution is the formation of multi-vector management of the development of critical infrastructure enterprises. Such a model should be aimed at prioritizing the solution of problematic issues of strategic management, enhanced by digitalization. Strategic management should be focused on identifying the adaptive capabilities of business strategies to digital challenges, introducing flexible response through operational management and specifying management decisions in the area of risk management. This will allow modernizing the existing strategies of critical enterprises, ensuring their sustainable operation in conditions of unprecedented uncertainty of wartime.
3. The features of strategic management of critical infrastructure facilities are that priority is given to redundancy, duplication of systems and protection of critical logistics nodes over long-term scaling of financial and economic activities, and the emphasis is on integrating the strategies of such enterprises with the interests of state, military and international structures, since the protection of critical infrastructure is a joint, global mission in the context of sustainable development goals. The strategy of a critical infrastructure enterprise should provide for a significant transformation of management to implement secure, cloud solutions and artificial intelligence tools, and long-term management decisions should combine planning of communications, evacuation routes and social support for the population. The successful implementation of strategies in wartime conditions depends on flexibility, the ability of management to quickly change directions, despite limited resources, large-scale destruction and increased competition.

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