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1 UKRAINE'S ACADEMIC POTENTIAL DURING THE WAR: UNDERSTANDING INFLUENCING FACTORS AND PRESERVATION STRATEGIES

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ABSTRACT

This chapter offers a comprehensive analysis and strategic plan for rejuvenating Ukraine's scientific landscape in the face of a protracted full-scale war and its impact on higher education institutions and the academic community. Considering the interaction of socio-economic, socio-psychological, professional and personal factors, the study highlights the serious challenges, faced by academic staff in maintaining and developing academic potential in new realities. Recognizing the preservation and sustainability of academic potential as one of the most important problems, the article argues for the positioning of education, science, technology and innovation at the center of Ukraine's strategic recovery. The proposed roadmap emphasizes the need for systemic reforms and the development of a sustainable institutional ecosystem that integrates people-centric and infrastructure-based strategies. A detailed analysis of 18 key elements, equally divided between people-centric and infrastructure categories, identifies specific actions, needed at different levels. These measures aim to respond to urgent needs while laying the foundation for the long-term sustainability, competitiveness and inclusiveness of Ukrainian higher education and science. The plan emphasizes the importance of international support in bringing funding, technology and expertise to meet the challenges of war, and emphasizes the critical need to ensure the physical safety of scientists, adapt infrastructure to military conditions, and promote innovative research and international cooperation.

This strategic approach requires active efforts to prevent the loss of academic potential and ensure the sustainable future of Ukraine as a nation with a high level of educational services and scientific research, which is integrated into the European Union. By harmonizing with European standards and the Sustainable Development Goals, supporting the development of high-tech industries necessary for the state's defense capability, and using the "Triple Helix" model of cooperation between academia, industry and government, this strategic plan defines a roadmap for the reboot and development of Ukrainian higher education and science. This roadmap is aimed not only at overcoming the immediate challenges of the war, but also at creating Ukraine as a free, independent and self-sufficient state with a vibrant and globally competitive academic community.

KEYWORDS

Ukraine, war, universities, triple helix, ecosystem, science, higher education, sustainable development goals, academic potential, intellectual capital, people-centeredness, infrastructure, roadmap.

1.1 INTRODUCTION

The start of a full-scale war in Ukraine in 2022 marked a critical period not only in the geopolitical landscape, but also in the field of higher education and science in the country. The academic community has faced unprecedented challenges, including direct and indirect losses and damages. This chapter analyzes the profound impact of the war on the academic potential of Ukrainian institutions of higher education, examining socio-economic, socio-psychological, professional and personal factors affecting the academic community.

The Sustainable Development Goals (SDGs) and the triple helix model of innovation, which includes interactions between academia, industry and government, serve as a foundation for analyzing today's challenges and planning for the future. These models help assess the consequences of the war and determine directions for the sustainable development of Ukraine's academic infrastructure. Particular attention is paid to Sustainable Development Goal 4, which emphasizes the need to ensure comprehensive and equitable quality education and continuous lifelong learning opportunities for all. Similarly, the triple helix model emphasizes the importance of collaborative efforts in fostering innovation and overcoming a range of problems, caused by the war.

Historically, wars have had a significant impact on academic sectors, primarily through the loss of intellectual capital. The outflow of personnel due to emigration or changing professional roles is one of the key problems that threatens the continuity and development of education and science. Unlike temporary impacts on physical infrastructure that can be rebuilt, the erosion of intellectual capital creates deeper and longer-term problems. The loss of highly qualified academic staff leads to a reduction in the quality of education and research, which affects the ability of future generations to achieve high academic standards. This creates a negative vicious cycle that can last for several generations, significantly slowing down innovation and scientific progress and reducing Ukraine's competitiveness on the international stage and slowing post-war reconstruction.

Based on the analysis of multiple challenges, faced by Ukrainian universities, strategies have been developed to preserve and strengthen academic potential. In embarking on this analysis, it is important to recognize the role of academic resilience not only in overcoming immediate crises, but also in laying the foundations for long-term post-war recovery.

1.2 REVIEW OF THE IMPACT OF THE WAR ON THE ACADEMIC POTENTIAL OF UKRAINE

With the onset of the full-scale war in Ukraine in 2022, higher education and science have been severely disrupted, exacerbating pre-existing vulnerabilities and creating new challenges. The war caused the destruction and damage of physical infrastructure, the depletion of financial resources, and the loss of intellectual capital, which led to the instability of academic potential [1, 2].

In terms of financial distribution, the war led to a marked reduction in research and development (R&D) spending. According to the UNESCO Institute for Statistics, the war reduced research

spending both in real terms (adjusted for inflation) and as a share of GDP [3]. Ukraine allocated 0.38 % of GDP to research and development (R&D) in 2021, but only 0.33 % of GDP in 2022. This corresponds to a fall in gross domestic research expenditure (at constant 2017 prices) from US$2,019.5 million at PPP to US$1,242.1 million at PPP. However, it should be noted that the scientific intensity of Ukraine has already decreased from 0.73 % of GDP in 2013 to 0.40 % of GDP by 2020 [3].

The full-scale war also caused serious damage to the physical infrastructure necessary for educational and scientific activities. According to research data, of those who remained in Ukraine, more than one-fifth of academic staff were unable to physically access their workplaces, while almost a quarter did not have access to "critical input data" for their research [4]. It is estimated that the damage from the restoration of the scientific infrastructure of Ukraine is approximately US$1.2637 billion, which includes the restoration of scientific equipment and buildings. From February 2022 to early 2024, about 1,443 buildings belonging to 177 public academic institutions were damaged or completely destroyed. More than 750 pieces of scientific and technical equipment, used in a wide range of scientific works, were damaged or destroyed [3]. However, this is only a part of the damage that was assessed. It is impossible to determine all the damage due to the location of some objects in the territories, temporarily controlled by Russian troops [5].

The occupation of the part of the territories of Ukraine by Russian troops not only led to significant destruction, but also necessitated the relocation of higher education institutions [6]. As of the beginning of 2024, 29 universities were temporarily relocated to a new place. This condition is caused not only by the ongoing war, but also by migration, which is in fact a disconnection from their campuses and physical infrastructure. This displacement has not only physical dimensions, but also profound academic and emotional consequences [7, 8]. These institutions were deprived of physical infrastructure, being left without classrooms, administrative offices, student facilities, research facilities and vital tools, needed to support the educational process [9].

This forced migration of the academic community and the loss of physical infrastructure reflected the wider crisis of higher education and science, caused by the war [10]. It affected not only physical space and resources, but also the essence of academic identity and the continuity of intellectual traditions. As universities struggle to adapt and recover in the face of uncertainty, the resilience and adaptability of the academic community are being tested for strength, highlighting the need to develop comprehensive strategies to support displaced higher education institutions and preserve academic potential [11].

The loss of human capital due to emigration, military actions and professional changes endangers the intellectual potential of education and science in Ukraine. This significantly reduces scientific density in the country and increases the risks of irreversible losses [12–14]. As of the beginning of 2024, a significant brain drain was recorded: 12 % of Ukrainian scientists and university teachers either emigrated (6.3 %) or became internally displaced persons (5.5 %) [3]. The migratory loss of human capital is of particular concern in light of the already low density of researchers in Ukraine, which was 587 per million people in 2023, the lowest rate in Europe, apart from Bosnia

and Monaco [15]. The continuation of the war increases the risks, associated with emigration, which may become irreversible. In addition, we are talking about the potential loss of mentoring for young scientists, which is one of the most important consequences of such migration losses.

In addition, the war and the special working conditions of the Ukrainian academic community during this period affected mental health. In peacetime, administrative responsibilities and methodological difficulties, as well as limited financial incentives, are typical difficulties for academic staff. Various studies focusing on stressors and workload indicate that academic staff in many countries of the world is constantly faced with high levels of stress, anxiety and other psychological problems [16]. The high demands of the working environment, the need to combine personal and professional obligations, as well as the constant pressure on productivity in the process of performing educational, research, mentoring tasks and professional development significantly affects mental health and general well-being [17].

Against the background of the full-scale war, these stressful factors were supplemented by new ones that required the search for internal resources to adapt to the new reality. At the beginning of the full-scale invasion, significant challenges were the interruption of studies, the loss of foreign students, the strengthening of the third mission of universities through active involvement in volunteer activities [18, 19], as well as the need to find new methods to ensure the continuity of education during the war [20].

According to UNESCO, more than 30 % of academic staff continues to work remotely [3]. This trend reflects the increasing adoption of digital tools and platforms that enable remote work, allowing researchers and educators to continue their activities outside the traditional institutional environment [14]. Such a transition caused a psychological burden, affected an increase in distress, a lower level of involvement in the community, and the restructuring of social contacts [21].

The uncertainty of career prospects is another significant challenge for academic staff. Uncertainty about future prospects has a profound effect on individual human behavior, affecting motivation, work strategies, and planning one's own future [22, 23]. When people face intellectual and professional uncertainty about future career prospects, they experience increased stress and anxiety, on the other hand, this can lead to proactive reassessment of career goals and consideration of new opportunities [24, 25]. However, in a period of full-scale war, the short- and long-term prospects for the professional development of academic staff are limited by uncontrollable external factors. Such factors include the duration of the war, changes in the professional environment, direct exposure to military action, including missile strikes, air strikes, and access to basic resources, such as electricity and stable internet [26, 27].

This review highlights the large-scale and multifaceted impact of the war on higher education and science in Ukraine. The destruction and damage of physical infrastructure, the reduction of funding and, most critically, the loss of intellectual capital – create significant challenges for the preservation and sustainability of Ukraine's academic potential. As the war continues, the need to address these challenges becomes increasingly urgent, laying the groundwork for future recovery and progress.

1.3 ASSESSMENT OF FACTORS AFFECTING THE ACADEMIC COMMUNITY OF UKRAINE IN THE CONDITIONS OF THE ONGOING WAR

1.3.1 METHODOLOGY

The study of the impact of socio-economic, socio-psychological, professional and personal factors on the academic community in the conditions of the ongoing full-scale war in Ukraine was conducted using a quantitative methodological approach. The study covered a wide range of academic staff of Ukrainian universities, who were involved through random sampling. The total number of respondents was 836 people.

The data, presented in **Table 1.1**, indicate that the presented characteristics of the sample of respondents are diverse in composition. At the same time, the general data on the respondents indicate that mainly middle-aged female academic staff (35–50 years old) joined the study. Most of the respondents have the scientific degree of PhD and hold the position of associate professor. Such a portrait of the respondents of the study generally reflects the demographic composition and professional structure of scientific and pedagogical workers of higher education institutions of Ukraine.

Table 1.1 Socio-demographic information about the respondents

Category	Subcategory	Number	%
Age	Under 35	127	15
	35–50	379	45
	51–60	275	33
	61 and older	55	7
Gender	Male	171	20
	Female	665	80
Scientific degree	Doctor of science	152	18
	PhD	536	64
	Master	148	18
Position	Professor	147	18
	Associate professor	464	56
	Teacher	148	18
	Assistant	77	9

The main tool for data collection was a questionnaire containing questions, aimed at determining the degree of influence of various factors during the period of martial law. The questionnaire included closed questions. The research was conducted in compliance with ethical standards,

ensuring confidentiality and anonymity of respondents. The study participants were informed about the purpose and nature of the study and gave informed consent to participate in it.

1.3.2 SOCIO-ECONOMIC FACTORS

Socio-economic factors include a wide range of conditions and variables covering economic stability, wage levels, physical infrastructure, social protection and the general security situation. These factors have a direct impact on the mental health and well-being of scientists, which, in turn, affects their ability to perform scientific and educational activities. In the conditions of the ongoing full-scale war in Ukraine, the study of these factors becomes especially relevant, since military actions and their consequences significantly affect the economic and social situation of the country, and therefore, the living conditions and work of academic staff. The study of these factors allows us to understand exactly how they affect the preservation of the academic potential of higher education institutions in such difficult conditions (**Table 1.2**).

Table 1.2 The influence of socio-economic factors on the academic staff of HEIs in the conditions of the ongoing full-scale war

Factor	Number	%
Lack of physical infrastructure at the new location of HEI	75	9
Lack of economic stability	450	53.8
Intensification of professional activity	233	27.9
Insufficient pay level	303	36.2
Lack of support from the state	139	16.6
Instability of social protection	230	27.5
Deterioration of the security situation	679	81.2
Nothing has changed	20	2.4

The presented data indicate that the most significant factor of influence in the conditions of the ongoing war is the deterioration of the security situation (81.2 %). This may indicate that the constant security threat creates a high level of stress and anxiety among academic staff, which complicates professional activity and negatively affects the academic potential of higher education institutions. Lack of economic stability (53.8 %) and insufficient pay (36.2 %) are also important, as financial uncertainty can impair mental health and motivation for research, limiting opportunities for research and professional development. The intensification of professional activity (27.9 %) and the instability of social protection (27.5 %) indicate an increase in workload and uncertainty in social guarantees, which can cause additional stress and affect mental health. At the same time, insufficient support from the state (16.6 %) and lack of physical infrastructure at the new location

of the higher education institution in the situation of relocation (9 %) are indicated by the smallest number of respondents. Despite this, it is important for this group of academic staff to be provided with the necessary resources and support for the possibility of continuing their professional activities. The smallest group of respondents (2.4 %) believes that the socio-economic situation did not affect the possibility of implementing educational and scientific activities.

The results of the conducted research emphasize the need for a comprehensive approach to preserve the academic potential of higher education institutions in the conditions of the ongoing war, which includes the search for security strategies, investments in physical infrastructure, social protection, and flexible conditions for educational and scientific activities.

1.3.3 SOCIO-PSYCHOLOGICAL FACTORS

Socio-psychological factors refer to various aspects of social interaction in the workplace, for example through effects on motivation, stress or cooperation. Consideration of these factors is important because they directly affect the psychological state and motivation of academic staff, and therefore the effectiveness of their scientific and educational activities in the conditions of uncertainty and crisis, associated with the ongoing full-scale war. **Table 1.3** presents the results regarding the influence of socio-psychological factors on the academic staff of higher education institutions.

Table 1.3 The impact of socio-psychological factors on the academic staff of HEIs in the conditions of the ongoing full-scale war

Factor	Number	%
Uncertainty of mutual relations in the staff of HEI institutions or in the higher education system in general	139	16.6
Lack of communication with colleagues	211	25.5
Change in the desire to work in the HEI or in the system of higher education in general	170	20.3
Lack of support from colleagues	47	5.6
Change of the motivation of professional activity	357	42.7
Destructive atmosphere in the staff	87	10.4
Change of relations in the staff of HEI	111	13.3
Nothing has changed	234	28.0

Analyzing socio-psychological factors in the context of the impact on the preservation of the academic potential of institutions of higher education during the ongoing full-scale war, it is worth highlighting the following key points. First of all, the change in the motivation of scientific and pedagogical activity (42.7 %) is the biggest influencing factor in conditions of uncertainty and

crisis. A decrease in motivation can lead to a decrease in productivity and a loss of interest in professional activities. Secondly, the lack of communication with colleagues (25.5 %) and the uncertainty of relationships in the staff of higher education institutions (16.6 %) emphasize problems in communication and mutual understanding at the workplace, which can affect teamwork and the effectiveness of the implementation of started projects and the initiation of new ones. In addition, the change in the desire to work in higher education institutions or in the higher education system in general (20.3 %) indicates a possible reorientation of professional interests or a lack of understanding of the meaning of educational and scientific work in the conditions of the full-scale war, which may lead to a decrease in the number of qualified specialists capable of producing scientific products that are important to the community, country and society. A certain part of the respondents noted that they are affected by the destructive atmosphere in the team (10.4 %) and the lack of support from colleagues (5.6 %). This can cause additional stress and reduce the sense of belonging to the academic community. At the same time, the presence of a significant number of respondents (28.0 %), for whom nothing has changed, may indicate the stability of some aspects of the working environment or a fairly quick adaptation to conditions of uncertainty and crisis.

The obtained results indicate that in order to preserve the academic potential of higher education institutions in the conditions of the full-scale war, it is necessary to pay attention not only to socio-economic, but also to socio-psychological factors. The creation of conditions for interaction and cooperation will contribute to the exchange of ideas and experience, the development of innovative projects and the increase of mutual support among colleagues during the full-scale war.

1.3.4 PROFESSIONAL FACTORS

Professional factors include aspects related to the working environment, working conditions, resources and tools necessary for scientific and pedagogical activity. The study of these factors is important for understanding the impact on the preservation and sustainability of the academic potential of institutions of higher education, especially in the context of the ongoing full-scale war. The analysis of professional factors allows us to identify key challenges, faced by academic staff, and develop strategies for adaptation and support of effective educational and scientific activities during the crisis events (**Table 1.4**).

The results, presented in **Table 1.4**, indicate that the work has started to take significantly more time and effort than before (69.7 %), and this is the biggest challenge. This indicates a significant increase in the workload of academic staff. This can affect not only their mental health, but also their ability to conduct quality research. The next factor, according to the respondents, is the unclear prospect of further activities of the higher educational institution (48.0 %). This highlights the high level of uncertainty among academic staff, which has a negative impact on strategic planning and a sense of stability in the professional field. The search for new tools (36.0 %) and the feeling of a lack of resources necessary for professional activity (30.7 %) indicate the need to adapt to new conditions

and find new solutions for the continuity of higher education and conducting research. The feeling of a lack of resources and the need to find new tools for educational and scientific activities can encourage academic staff to innovate and take a creative approach to work. However, it can also lead to additional stress and fatigue, as adapting to new conditions takes time and effort. Destruction and damage to the physical infrastructure of HEI (10.3 %) and its relocation (9.1 %) indicate serious physical losses of the infrastructure, which requires efforts to restore and adapt to new conditions. This creates additional challenges to ensure proper conditions for educational and scientific activity and can affect not only the quality and productivity of work, but also the mental state of academic staff.

Table 1.4 The influence of professional factors on the academic staff of HEIs in the conditions of the ongoing full-scale war

Factor	Number	%
Feeling of lack of resources necessary for scientific and pedagogical activities	257	30.7
The prospect of further activities of HEI is unclear	401	48.0
Transfer of HEI to a new location	76	9.1
Search for new tools	301	36.0
Updating of the normative and legal framework of the activity of HEI	58	6.9
Work takes much more time and effort than before	583	69.7
Destruction and damage to the physical infrastructure of HEI	86	10.3
The need to find new approaches, resources and means	160	19.1
Nothing has changed	35	4.2

1.3.5 PERSONAL FACTORS

Personal factors include the psychological characteristics, emotional state and internal experiences of academic staff that can influence behavior, productivity and the ability to perform effective and productive professional activities (**Table 1.5**). The study of personal factors is important for the preservation and sustainability of the academic potential of institutions of higher education, because it allows us to understand how emotional state and psychological well-being affect the ability to engage in educational and scientific work under conditions of stress and instability, associated with the ongoing war.

The personal factors, identified in the study, indicate a profound impact of the ongoing war on the mental health of academic staff. The empirical data, presented in **Table 1.5**, indicate that constant worry about the fate of the country, city, university (75.2 %) and anxiety (72.3 %) are the dominant factors that indicate a high level of emotional tension. Such a condition can significantly affect concentration, work productivity and the ability to focus on long-term scientific projects. A constant feeling

of danger (54.4 %) and constant stress (54.7 %) highlight that security and stability are key factors for psychological well-being. These conditions are critical to maintaining academic potential because they affect the capacity for creativity and innovation. The difficulty of professional self-realization (27.8 %) and the difficulty of rebuilding one's activities in accordance with new conditions (18.8 %) indicate problems of adaptation to changed working and living conditions. In the conditions of the war and its consequences, it is difficult for scientists to find optimal ways to realize their potential.

● **Table 1.5** The influence of personal factors on the academic staff of HEIs in the conditions of the ongoing full-scale war

Factor	Number	%
Constant feeling of danger	438	54.4
Inability to control emotional state	134	16.0
Constant concern for the fate of the country, city, university	629	75.2
Anxiety	604	72.3
Constant stress	457	54.7
The difficulty of professional self-realization	232	27.8
The difficulty of rebuilding one's activities in accordance with new conditions	157	18.8
Nothing has changed	23	2.8

In summary, the data, presented in **Table 1.5**, indicate a profound influence of personal factors on the mental health of academic staff. A high level of anxiety, a constant feeling of danger and difficulties in adapting to new conditions create serious challenges for maintaining productivity and developing scientific research and educational activities. This emphasizes the need to develop comprehensive programs of psychological support for the academic community, as well as to create conditions that contribute to the preservation and development of academic potential in crisis conditions.

1.4 PRESERVATION OF UKRAINIAN ACADEMIC POTENTIAL IN THE CONDITIONS OF THE WAR: UNDERSTANDING EXIT POINTS AND IMMEDIATE ACTIONS

The Ukrainian academic community, faced with unprecedented challenges, united, demonstrating extraordinary resilience and resourcefulness. Numerous initiatives play an important role in this process, each of which is aimed at meeting both immediate and long-term needs of Ukrainian higher education and science.

The ScienceForUkraine initiative, which was launched on February 26, 2022, reflects the proactive stance of the academic community in response to the crisis. Led by volunteer researchers and students from numerous academic institutions in Europe and beyond, this initiative quickly

recognized the urgency of the situation. With offices in 32 countries, the movement has created an extensive network spanning the scientific, educational and business sectors to support the Ukrainian academic community. The initiative actively develops and distributes support programs, aimed not only at supporting the Ukrainian academic community during the war, but also at strengthening its position in the international arena.

In parallel with these efforts, the cooperation between the popular science media platform "Kunsht" and Ukrainian scientists ended with the creation of a bilingual web platform Science at Risk. This initiative aims to demonstrate the experience of the Ukrainian academic community, promote international partnership and talk about the challenges, caused by the war. It focuses mainly on assessing the situation in the country and finding ways to solve both urgent and strategic problems facing the scientific community. Work within the framework of the "Science under threat" initiative is built around three main goals: preservation of science that is in danger of disappearing; communicating the scientific effort during the war and promoting the recovery of science after the war. Initial efforts led to the creation of analytical documents, aimed at these goals, as well as the creation of databases cataloging damaged physical infrastructure and the compilation of a registry of Ukrainian experts.

The launch of the platform of the Ukrainian scientific diaspora was a significant step towards the unification of the Ukrainian academic community of different waves of migration. This initiative aims to harness collective expertise for resilience, recovery and increased integration into the global academic community.

At the state level, the introduction of the research infrastructure mapping initiative means a strategic approach to attracting existing resources for scientific research in Ukraine, as well as the active involvement of civil society in providing space and resources to academic staff emphasizes a comprehensive response to the challenges, caused by the war.

In joint efforts, aimed at mitigating the impact of the conflict on Ukrainian higher education and science, higher education institutions actively sought cooperation with foreign organizations and immersed themselves in international projects. In particular, participation in European Union programs, such as Horizon Europe, NATO Science for Peace and Security, and Erasmus Capacity Building, among others, underscores the strategic turn toward international cooperation to rejuvenate the academic infrastructure. The mobilization of international support, especially during martial law, played an important role in facilitating access to the resources, needed to reconstruct and modernize the operational framework in these institutions. An important aspect of this international involvement was the initiation of resident and non-resident scholarship programs, aimed at providing assistance to Ukrainian academics, affected by the war, underscoring the global commitment to ensure the continuity of Ukrainian academic contributions.

In parallel with international efforts, the Ukrainian academic landscape is characterized by stable internal support mechanisms, including funding of state scientific projects. An important step in this area was the optimization of the deadlines for submission of state budget projects, which accelerated the process of financing new research topics from the beginning of the year, thereby guaranteeing a continuous flow of scientific research.

During the war, the National Research Fund of Ukraine played a key role in the development of scientific research, launching several competitions, aimed at financing a wide range of projects. Among them are such initiatives as "Science for the reconstruction of Ukraine in the war and post-war periods", aimed at solving the immediate and future challenges of rebuilding the nation; "Science for Strengthening Ukraine's Defense Capability", which focuses on strengthening national security through scientific innovation; and Cambridge – NFSU 2022; individual Research (Development) Grants for Ukrainian Scholars, supported by the University of Cambridge, to help researchers from war-affected universities. In addition, "Joint Ukrainian-Swiss projects on the implementation of scientific research" and "Advanced science in Ukraine" further expand the horizons of scientific research, promote international cooperation and innovation.

A special structural project for Ukraine within the framework of the Erasmus+ program, which starts work in 2024 and will provide an opportunity to create a digital ecosystem, in particular for the interaction of Ukrainian institutions and providing students with access to quality education, overcoming the challenges of the martial law in Ukraine, was a powerful support of the European community. A significant step towards the modernization of the Ukrainian higher education system is embodied in the project "Open science for the Ukrainian higher education system Open4UA", which is supported by the Erasmus+ program Capacity building in higher education. This initiative champions the cause of open science, aiming to overhaul the higher education system, prioritizing the transparency and accessibility of scientific research. In addition, it seeks to improve the evaluation of scientific activity in accordance with the principles of CoARA, marking a significant step in the direction of the integration of Ukrainian science into world standards and practices.

These collective efforts, both on the international front and in the Ukrainian context, emphasize a dynamic and multifaceted approach to the preservation and sustainability of the system of higher education and science during martial law. Through strategic partnerships, funding initiatives and commitment, it not only seeks to overcome the challenges, caused by the war, but also lays the foundation for a strong and innovative academic community that is poised to make a significant contribution to the global knowledge economy.

1.5 A REFLEXIVE VIEW OF THE CURRENT SITUATION: INFRASTRUCTURAL AND PEOPLE-CENTERED STRATEGIES FOR OVERCOMING CHALLENGES

1.5.1 IDENTIFICATION OF INFRASTRUCTURE PROBLEMS AND CASES OF OVERCOMING CHALLENGES

The collective response of the academic community to the challenges of ensuring the survival and continuity of educational and scientific activities in a rapidly changing environment highlights a number of important issues that require immediate attention. One of the most difficult is the

restoration of physical infrastructure in conditions of war, which is complicated by constant risks. Despite the obstacles, the cessation of educational and scientific efforts due to a lack of infrastructure is considered unacceptable. Therefore, initiatives, aimed at restoring and modernizing infrastructure, which serve as the basis for supporting the academic community in this crisis period, are critically important.

Rebuilding infrastructure during martial law is a major challenge due to the risks inherent in full-scale war, which offers no guarantees of security. The imperatives of continued educational and scientific activity despite these uncertainties underscore the importance of initiatives, aimed at restoring and modernizing academic resources. Such efforts are vital to providing the academic community with the means to adapt and persevere in these difficult times, reflecting the commitment to the continuity of scientific work.

A reduction in international support can exacerbate the vulnerability of the academic ecosystem, deepening internal conflicts and discontent, which negatively affects the quality of education and research. This, in turn, creates significant obstacles to the achievement of the global sustainable development goals and increases risks to regional and global security. In addition, the prospect of a "brain drain", fueled by the departure of personnel in search of better working conditions, threatens to reduce the country's academic potential over time. Therefore, the role of international cooperation in rebuilding the academic infrastructure of Ukraine, which is crucial for innovation and post-war recovery, is integral.

The motivational dynamics of the academic community, especially among faculty and students, underwent significant changes under the pressure of the war, highlighting the challenges in maintaining engagement and high-quality education. Addressing these changes in the motivational landscape is critical to fostering a sustainable and productive academic community. Reforms, aimed at bringing the system of education and science of Ukraine closer to European standards, including the optimization of the network of higher education institutions, create additional challenges, but they have the potential not only to solve immediate problems, but also to lay the foundation for a more sustainable and innovative Ukrainian scientific and educational system systems.

The lack of physical infrastructure is another significant challenge for the implementation of educational and scientific activities. The lack of necessary infrastructure – from laboratories and classrooms to technological tools, such as computers and Internet access, – holds the academic community back from conducting research, innovation, and providing quality education.

In general, the path of development of Ukrainian science and education, although full of challenges, is also full of opportunities for reforms, sustainability and renewal. The direct solution of these problems, the concerted efforts of the national and international community, is important for ensuring the viability and development of Ukrainian science during the war and after its end. Recognizing the many challenges, faced by the sector, not only outlines the scale of the obstacles but, more importantly, lays the groundwork for developing effective solutions. It is in identifying these challenges that we recognize the contours of potential solutions, turning threats into opportunities for resilience, recovery and innovation.

The concept of "threats become opportunities" is not only theoretical, but also manifests itself in the adaptation and innovative responses of Ukrainian universities to new realities. For example, the adoption of the "University without walls" model by Berdyansk State Pedagogical University (BSPU) not only ensured the continuity of education despite physical and material-technical limitations, but also paved the way for new approaches to educational activity and scientific research. It helped overcome traditional boundaries, using Centers for the collective use of scientific equipment and integrating with foreign scientific centers and laboratories. Due to the seamless integration of distance learning technologies and the deployment of digital platforms, BSPU has ensured a steady educational continuum. This change not only contributed to the rapid recovery of activities in the conditions of temporary displacement, but also contributed to the university's leadership in scientific rankings, noting a significant increase in research efficiency. Among these changes, BSPU has maintained a high level of academic staff and student contingent, embodying the synthesis of project and network models, characterized by flexibility, openness and a propensity for innovation in the management of educational and scientific activities.

Taras Shevchenko Luhansk National University, originally located in Luhansk and transferred to Starobilsk in August 2014, and later to Poltava, Myrhorod and Lubny after 2022, demonstrates the ability to adapt, preserving traditional models of educational and scientific activity. Despite dislocations and the need to quickly respond to crisis situations, the university has maintained an unwavering commitment to basic research, academic freedom, and long-term educational values. This adherence to traditional academic principles not only contributed to the preservation of educational and scientific activities, but also allowed the institution to explore new ways of development and integration in the conditions of the changed socio-economic landscape of Ukraine.

In connection with the move to Vinnytsia in November 2014, Vasyl Stus Donetsk National University made significant efforts to restore and adapt research and educational programs. Proactive expansion of the university's fund-raising activities and establishment of strong partnerships with the international scientific community played an important role in providing both financial support and valuable knowledge exchange. The priority task is to preserve and strengthen the academic community; the institution has provided high-quality education and scientific activity. This approach resonates with the triple helix model, emphasizing the synergistic relationship between university, industry and government in the flourishing of science and education.

After two moves – first to Sievierodonetsk in 2014 and then to Kyiv in 2022 – Volodymyr Dahl East Ukrainian National University is a testament to sustainability and innovation. The university skillfully integrated elements of network and project models, introducing hybrid forms of education and promoting active international cooperation. The well-established distance learning system made it possible to quickly resume the educational process after each move, preserving and expanding the institution's academic potential. Despite the turmoil, caused by the war, the university successfully implemented numerous international and national projects, modernizing its scientific infrastructure and strengthening interdisciplinary research, thus demonstrating the effectiveness of the hybrid model in managing changes.

Mariupol State University, relocated to Kyiv, embodies the network model of adaptation to new conditions. This model, which promotes the development of both fundamental and applied research, has paved the way for the expansion of international cooperation with scientific institutions and business organizations. The university has strengthened its support for the scientific activities of students and postgraduates, encouraging their participation in international scientific projects and programs. Thanks to flexible financing mechanisms and integration into the international scientific community, Mariupol State University not only strengthened its academic potential, but also ensured the continuity of its activities.

The coping strategies, used by these universities, highlight the critical importance of innovative organizational models to sustain scientific activity in new realities. Using the principles of the triple helix model and implementing hybrid and network approaches, these institutions not only overcame the challenges of displacement, but also positioned themselves as key contributors to the resilience of Ukraine's higher education and science system during martial law.

At the same time, the resilience and adaptability, demonstrated by the academic sector, underscore the critical importance of collaborative efforts to overcome the obstacles, created by the war. It is thanks to such synergy between national initiatives and global support that stability and continuity of higher education and science can be ensured in conditions of war. In addition, the current crisis opens an unprecedented opportunity for systemic reforms in the educational and scientific environment of Ukraine. These necessary reforms have the potential not only to address immediate challenges, but also to create a foundation for a more sustainable, innovative, and internationally integrated Ukrainian science and education system.

To sum up, awareness of the challenges facing Ukrainian science is the first step to overcoming them. With a clear understanding of these obstacles, the Ukrainian academic community, with the support of international allies, can turn these threats into catalysts for comprehensive reforms and sustainability.

1.5.2 HUMAN-CENTEREDNESS AS A TOOL FOR MAINTAINING MENTAL HEALTH

Active discussion of mental health issues is important for supporting the Ukrainian system of higher education and science. The inadmissibility of underestimating the importance of caring for the mental health of the academic community during the war indicates the need for a comprehensive approach to solving this problem.

Before the start of the full-scale war, the system of higher education and science in Ukraine faced the absence of both state and institutional programs to support mental health among the academic community. The situation worsened significantly after the start of the full-scale war in Ukraine, when the academic staff was forced to adapt to the new reality – to continue the implementation of educational and scientific activities during air raids, blackouts, teaching students who survived trauma, migrating to safer locations, undergoing psychological and physical torture

by the occupying forces, avoiding artillery fire and bombing, and at the same time struggling with own psychological problems [28]. This heroic display of strength, resilience and courage is deeply admirable, but the value of the internal resources, required to adapt to this new reality, must be recognized and appreciated.

A simplified strategy of personnel replacement through the attraction and training of new employees may have negative consequences for the Ukrainian educational and scientific systems. In particular, this relates to the time, required for learning and adaptation, and the economic impact of mental health problems, which goes beyond direct health care costs to include lost productivity and their impact on the economic development of a country. Even in countries with stable economic development, the economic costs of treating mental disorders are projected to increase significantly in the coming years, underscoring the need for increased attention and resources to address this problem [28].

In the context of the full-scale war in Ukraine, the unpredictability of its duration makes it difficult to predict the consequences for the mental health of the population. The data, presented in individual studies, are troubling. A comprehensive review, conducted by Yurtsenyuk and Sumariuk [30], indicates a high prevalence among Ukrainians of mental disorders, caused by the full-scale war. The work notes that according to the World Health Organization (WHO), as a result of armed conflicts, every fifth person may face mental problems. This means that approximately 9.6 million Ukrainians are potentially at risk of developing such disorders as depression, anxiety disorder, and stress-related disorders, including post-traumatic stress disorder (PTSD).

After two years of the full-scale war in Ukraine, problems such as stress, anxiety, and exhaustion are becoming more common, and can hinder productivity and creativity as important components of professional activity [31]. The long-term impact of high levels of stress on the mental health of the academic community can be severe and devastating. Research highlights that chronic stress can cause a number of mental health problems, including anxiety, depression, burnout, and reduced job satisfaction. Constant exposure to stress can lead to a decrease in the quality of work, an increase in cases of incapacity for work and sick leave [32]. In addition, chronic stress can interfere with daily functioning, emotional stability, and lead to the development of other mental disorders, such as anxiety and depression [33]. Teachers who experience high levels of stress are prone to the risks of reduced performance, uncontrolled anger, excessive anxiety, mental fatigue, and professional burnout [34]. These stress-related problems not only affect the mental health and well-being of the academic community, which can manifest in a decrease in the quality of teaching, a limitation of research activity and the search for innovation, as well as a potential exit from the academic profession. The results of our study confirm this trend, revealing high levels of anxiety and stress among the respondents.

Also, Ukrainian society continues to remain stigmatized regarding mental health issues [35]. Stigma becomes a major barrier to seeking help, and historical distrust of the psychiatric system and fears of negative perception only increase reluctance to seek help [36]. This indicates that taking care of one's psychological state, maintaining a balance between work and personal life,

observing psychohygiene measures are not widespread phenomena even in stable conditions. Crisis contingencies such as war increase the need for this. But the majority simply does not understand the need and does not know how to take care of themselves.

At the national level, the initiative of the First Lady of Ukraine "How are you?" is an important step in increasing mental health awareness and self-help practices. However, there is an obvious need for a comprehensive and systemic approach to promoting positive change in academia and the workplace. This requires the implementation of specific actions at various levels – from the state to the institutional and personal – that is critically important.

Within the framework of the key thesis of our research, which states that "Universities are formed by people", it is necessary to deeply consider the psychological state of the academic staff at various levels. This aspect is crucial because it can significantly affect productivity, innovation and the ability to make academic contributions, which are critical to the preservation and sustainability of academic capacity during martial law. Investing time and resources in solving this complex problem – mental health care in martial law conditions – can bring significant benefits to the post-war reconstruction of Ukraine in the fields of science, education, entrepreneurship and economy.

At the state level, it is important to introduce certain standards of mental health, well-being and safety in the workplace, which can become a reference point for scientific and educational institutions in building their flexible and accessible trajectory of creating a favorable educational environment for all. For example, Canada has an appropriate standard of care for mental health and psychological safety in the workplace [37]. This standard provides a set of voluntary guidance, tools and resources, designed to guide organizations in promoting mental health and preventing psychological harm at work.

At the institutional level, it is important to develop a culture of caring for mental health and well-being, formulate institutional policies and create conditions for improving the psychological climate of the academic community. This requires a rethinking of institutional policies and the formulation of a collective agreement, which would soften the conditions for excessive martial law work during tenure and promotion criteria, improve job security and the status of the scientific and pedagogical contract worker, and eliminate uneven effects of work on academic performance. At the institutional level, the implementation of various practices, such as the organization of trainings, free psychological counseling, support groups, etc., are effective. In addition, higher education institutions can collaborate with community organizations to scale up best practices.

At the individual level, the responsibility for one's own mental health and compliance with the principles of psychohygiene lies with everyone. Awareness of this responsibility becomes a fundamental step in minimizing the impact of stressors. Academic staff can apply a variety of strategies and develop self-help skills, aimed at ensuring their own mental well-being, which in turn will contribute to improving their personal and professional lives under martial law. Such measures may include seeking professional help, using stress management techniques, exercising regularly, getting adequate rest, and actively interacting with colleagues within and outside the academic community.

In addition, higher education institutions have an important role to play in supporting and developing this responsibility by providing the necessary resources, creating supportive policies and

cultivating an environment where mental health care is part of the experience. This integrated approach not only benefits everyone individually, but also contributes to the creation of a sustainable, productive and adaptive academic community, which plays a key role in the development of science and education in Ukraine.

Therefore, the creation of mental health standards and institutional policies, the development of a culture of caring for mental well-being, as well as the personal responsibility of everyone for their mental health are key elements in overcoming stress and ensuring the sustainability of the academic community.

1.6 THE FRAMEWORK OF SUSTAINABLE DEVELOPMENT GOALS AND THE TRIPLE HELIX MODEL AS A LENS FOR THE DEVELOPMENT OF STRATEGIES FOR PRESERVING THE ACADEMIC POTENTIAL OF UKRAINE

In the face of the multifaceted crisis, caused by the war in Ukraine, especially its profound impact on higher education and science, two conceptual frameworks stand out as tools for analyzing and shaping recovery strategies: the Sustainable Development Goals (SDGs) [38] and the Triple Helix Model [39]. These frameworks not only provide a structured approach to understanding current challenges, but also suggest ways to preserve and sustain academic potential.

1.6.1 SUSTAINABLE DEVELOPMENT GOALS

Adopted by the United Nations in 2015 as a universal call to action to end poverty, protect the planet and ensure peace and prosperity for all by 2030, the Sustainable Development Goals comprise 17 interrelated goals. In particular, Goal 4 – ensuring inclusive and fair quality education and promoting lifelong learning opportunities for all – is particularly relevant in the context of Ukraine's current problems. The Development Goals emphasize the critical role of education as a fundamental right and a cornerstone of sustainable development. In times of war, this goal emphasizes the importance not only of rebuilding physical infrastructure, but also of ensuring that education systems are inclusive, sustainable and adaptable to the needs of displaced populations and the changing landscape of higher education and science.

Mental health and well-being (Goal 3) is important, recognizing the significant impact of war not only on the physical health but also on the mental well-being of the academic community. Strategies for rebuilding intellectual capital should include programs to support mental health and resilience, as well as research initiatives to address health challenges, exacerbated by war to promote societal healing and sustainable health systems.

The pursuit of gender equality (Goal 5) has become increasingly critical as the war has disproportionately affected gender parity, including in academia. Efforts to reconstruct the educational

landscape must prioritize equal access to opportunities regardless of gender and address gender inequalities, exacerbated by war. The introduction of mobilization laws, which restrict men from going abroad, has become a serious challenge to their academic freedom and opportunities for growth. This limitation prevents male scientists from participating in international collaborations, attending conferences and participating in exchange programs, which are often crucial for academic and professional development. In this context, it is important to find balanced solutions that promote the advancement of women and girls in academia, while taking into account the limitations, imposed on men, ensuring that the academic community can develop in an inclusive and equitable way despite the challenges, caused by the war.

Goal 9 "Industry, Innovation and Infrastructure" emphasizes the need for sustainable infrastructure and the promotion of sustainable industrialization and innovation in academia. The renovation of educational and research facilities provides an opportunity to modernize and integrate advanced technologies, fostering a vibrant culture of innovation through industrial partnerships.

In light of the relocation of universities, Sustainable Cities and Communities (Goal 11) emphasize the importance of creating an inclusive, safe and sustainable academic environment. This goal encourages the development of educational campuses that serve as adaptive hubs for community recovery and sustainability, ensuring resilience to future challenges.

Goal 13 "Climate Action" is imperative because the environmental consequences of war intersect with the broader crisis of climate change. Universities and research institutions are tasked with leading by example by ensuring sustainability in their recovery efforts and by instilling the importance of environmental protection in their education and research programs.

Goal 16 "Peace, Justice and Strong Institutions" emphasizes the fundamental need for peace and inclusiveness in rebuilding Ukraine's academic and scientific sectors. Creating a barrier-free and equitable environment is critical to fostering the intellectual and social development necessary for long-term stability and prosperity.

Finally, "Partnership for the Achievement of Goals" (Goal 17) emphasizes the importance of cooperation to overcome the challenges, faced by educational and research institutions of Ukraine. International partnerships can provide critical support by offering the resources, expertise and sense of global solidarity essential to sustainable recovery.

In the ambiguity of challenges and opportunities that define the post-war landscape of Ukrainian science and education, the Sustainable Development Goals (SDGs) offer a framework for recovery and sustainable development. While each of the SDGs plays a crucial role in this, Goal 11 – Sustainable Cities and Communities – takes on particular importance in the context of the recovery of higher education institutions. Today, these institutions are increasingly adopting a third mission: serving the community. This role goes beyond traditional academic functions, positioning universities as the main agents of social and economic reintegration of war-affected territories.

This expanded role is particularly appropriate for the country's post-war reconstruction, where the reintegration of war-torn territories is a priority. Higher education institutions can act as magnets, attracting young people and fostering a sense of belonging and community. By providing

education, research opportunities and community services, universities have the potential to play a critical role in the socio-economic regeneration of these areas.

The implementation of Goal 11 in the context of Ukrainian higher education and science involves the development of campuses and academic programs that are not only sustainable, but also deeply integrated with the needs of local communities. This involves creating an inclusive, safe and sustainable learning environment that encourages the university community from diverse backgrounds, including de-occupied and war-affected regions, to participate in the recovery process.

In addition, universities, which act as centers of communities, can play a key role in the demographic and economic revival of the de-occupied territories, attracting young people to active participation in local development. By offering programs and initiatives, aimed at solving local problems, promoting sustainable development and innovation, higher education institutions can attract students and academic staff who are eager to contribute to the development of their communities.

This model of community-engaged higher education and science is also in line with the broader goals of sustainable development, contributing to local economic growth and social cohesion. It emphasizes the role of academic circles not only in the dissemination of knowledge, but also in its application in real conditions to solve urgent local and global problems.

For the effective implementation of the transformational role of universities in serving their communities and helping in the reintegration of war-torn territories, as envisaged in the framework, the adoption of the triple helix model becomes relevant. This model, which emphasizes synergistic collaboration between academia, industry and government, provides a solid foundation for Ukraine's post-war recovery.

1.6.2 TRIPLE HELIX MODEL

The triple helix model presents a theoretical framework that elucidates the synergistic interaction between three major societal sectors: academia, industry, and government. It suggests that the most favorable environment for innovation and economic development arises from joint efforts and mutual reinforcement between these three sectors. This model provides a robust theoretical framework for analyzing the dynamics of knowledge creation, technological progress, and societal progress, especially in contexts facing the challenges of recovery and development (**Fig. 1.1**).

At the core of the triple helix model is the concept of a "knowledge society", where the generation, dissemination, and application of knowledge are key to economic development and societal well-being. Universities play a crucial role in this model, generating new knowledge through research and innovation, and developing intellectual capital through education [40]. Industry, on the other hand, applies this knowledge to develop new technologies, products and services, contributing to economic growth and solving societal problems. Government in this triad provides the regulatory framework and policy support, needed to facilitate this interaction by investing in research and development (R&D) and creating incentives for innovation.

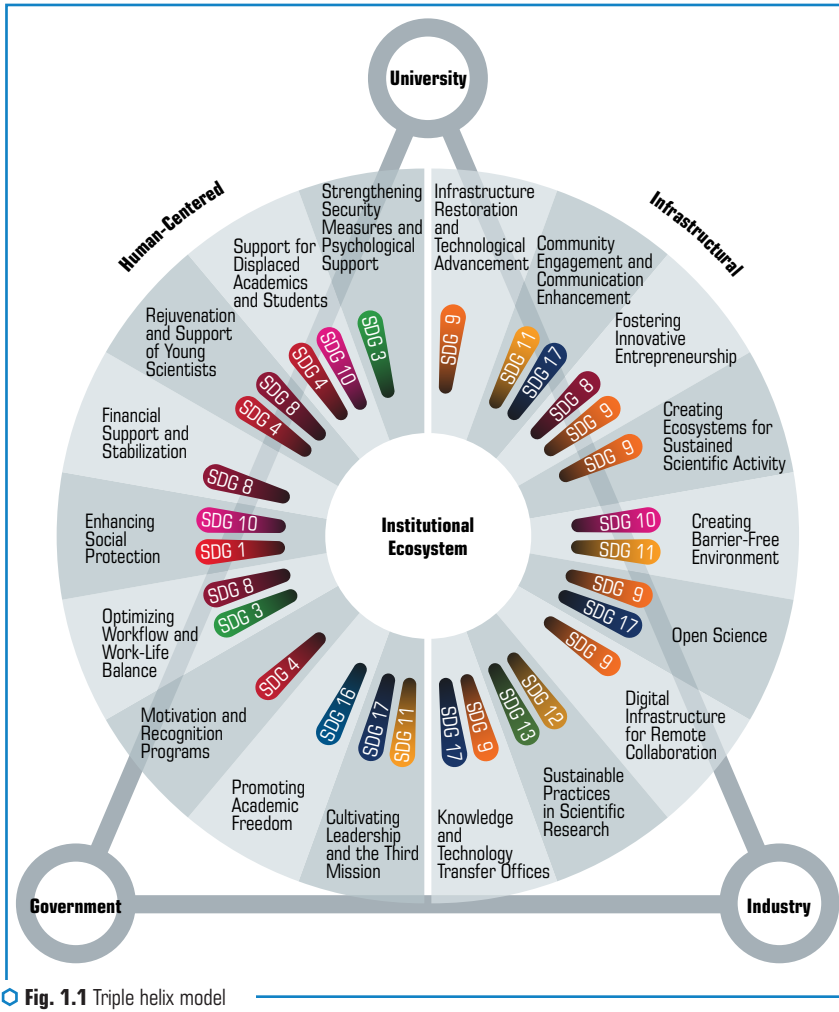

Fig. 1.1 Triple helix model

One of the key strengths of the triple helix model is its emphasis on the fluidity and overlap of roles between the three helices. Universities can take on an entrepreneurial role, contributing directly to economic development through technology transfer and startup incubation. Similarly, industry can contribute to knowledge production through applied research and joint projects with academia. The government's role goes beyond regulation and funding to a facilitator of partnership and collaboration in academic initiatives.

The model also emphasizes the importance of an institutional ecosystem that supports the preservation of academic potential and innovation. This includes the development of science parks, innovation clusters and technology incubators that physically co-locate academic, industrial and government institutions to facilitate collaboration. Such ecosystems enable the rapid exchange of ideas and resources, speeding the path from research to market and ensuring that scientific advances are translated into societal benefits.

In the context of the new realities of Ukraine, the Triple Helix Model offers valuable insights into how the reconstruction of the academic sector can be used to stimulate innovation and sustainable development. By developing close cooperation between universities, industry and government, Ukraine can not only restore its educational and scientific infrastructure, but also preserve its academic potential. This approach aligns with the broader goals of nation-building in an innovative, inclusive and sustainable way, ensuring that academic communities play a central role in shaping Ukraine's future.

The application of the triple helix model in the process of recovery of Ukraine involves several key considerations. First, it indicates the need for policies that support the reconstruction of educational and scientific infrastructure, facilitate the return or replacement of displaced academic staff, and encourage the development of innovative educational and research programs. Second, it highlights the potential of industry partnerships to provide financial resources, technological tools and practical opportunities for education, science and innovation. Finally, it highlights the importance of government involvement in creating an enabling environment for these collaborative efforts through supportive policies, funding mechanisms and strategic planning.

Together, the Sustainable Development Goals and the Triple Helix Model form a solid basis for analyzing the challenges, faced by the Ukrainian system of higher education and science in the war, and for developing strategies for its recovery and ensuring the sustainable development of academic communities.

1.7 ROADMAP FOR BUILDING THE INSTITUTIONAL ECOSYSTEM FOR THE PRESERVATION AND SUSTAINABILITY OF ACADEMIC POTENTIAL

Given the ongoing war and the need for post-war reconstruction, rebuilding Ukrainian higher education and science requires the creation of a strong institutional ecosystem. This ecosystem must be based on two fundamental pillars: people-centricity and infrastructure, developing in accordance with the Sustainable Development Goals (SDGs) and the principles of the triple helix model to create an environment that promotes sustainable development, resilience, inclusiveness and competitiveness (**Fig. 1.2**).

The human-centered pillar emphasizes the importance of well-being, development, and empowerment for the academic community. This includes comprehensive support for those displaced by war, providing them with uninterrupted access to quality education and research. It also envisages rejuvenating scientific potential, ensuring financial stability, strengthening social protection and

promoting academic freedom. Focusing on the human factor, this pillar seeks to motivate, attract and retain talent in Ukraine, recognizing that the strength of Ukrainian education and science is inextricably linked to the viability and sustainability of intellectual potential.

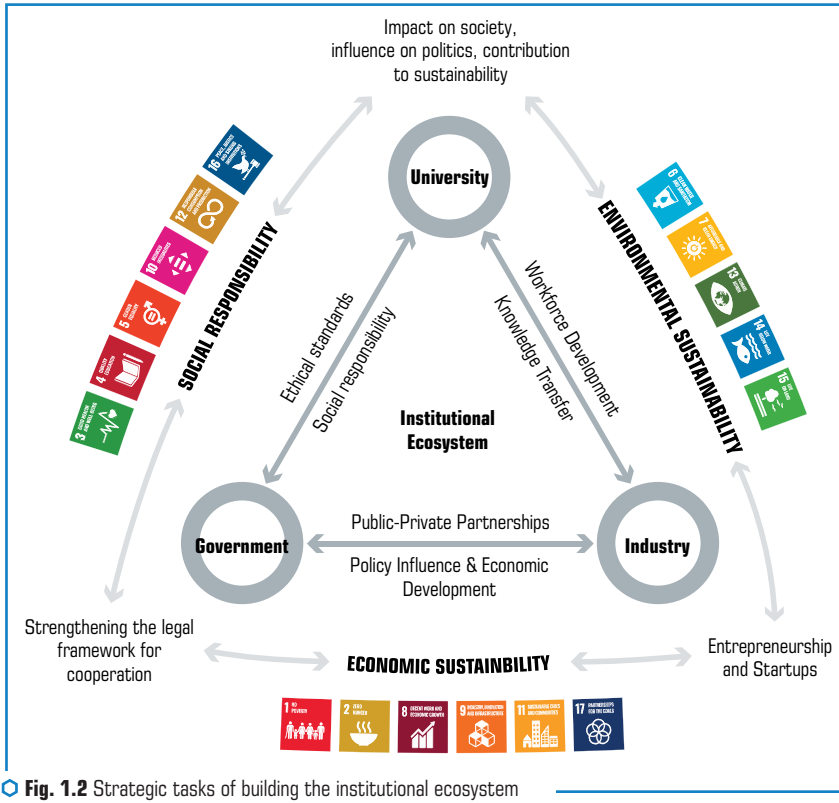

Fig. 1.2 Strategic tasks of building the institutional ecosystem

The infrastructure pillar emphasizes the need to build a physical and organizational structure that supports educational activities and scientific research, promoting collaboration. It includes restoration of damaged facilities, modernization of physical infrastructure to promote innovation, creation of institutional ecosystems for sustainable scientific activity, integration of innovative entrepreneurship, educational innovation, open scientific practices, development of a barrier-free and digital environment for collaboration.

Integrating the SDGs into the strategic plan provides a blueprint for addressing broader societal and environmental issues through education and science. Combining people-centric and

infrastructure pillars with specific SDGs, such as quality education, industry, innovation, infrastructure and sustainable cities and communities, the institutional ecosystem for Ukrainian science becomes a catalyst for sustainable development, contributing to solutions that are both global and local.

The triple helix model, with its emphasis on collaboration between academia, industry and government, enriches the institutional ecosystem, fostering synergy and innovation. This model encourages universities to be entrepreneurial, provides industry with knowledge, and provides an active role for government in cooperation and support. The integration of these elements ensures that the ecosystem remains dynamic, adaptable and capable of contributing to economic growth and societal development.

STRENGTHENING SECURITY MEASURES AND DEVELOPING A SYSTEM OF PSYCHOLOGICAL SUPPORT

At the university level, the introduction of comprehensive security measures and psychological support systems plays a critical role in creating a safe and inclusive environment for the academic community. The implementation of enhanced campus security, psychological first aid and the development of wellness programs should aim not only to protect the physical well-being of the community, but also to address the mental health problems that are exacerbated by the ongoing war.

The role of the state is to provide the necessary political framework and funding for the implementation of these university-led initiatives. This could include allocating resources for campus security infrastructure and subsidies for mental health services. In addition, the state should promote collaboration between universities and mental health organizations to ensure the academic community has access to professional support.

Internationally, partnerships with global academic and medical organizations can provide additional resources and expertise to support university- and government-initiated efforts. Such cooperation can facilitate the exchange of best practices in psychological support and safety protocols, ensuring that the Ukrainian academic community benefits from global innovations and ideas.

The implementation of comprehensive safety and psychological support measures at the university level directly contributes to SDG 3 (Good Health and Well-being) by protecting the physical and mental health of the academic community in the context of wartime challenges. The provision of government support and funding for these initiatives contributes to SDG 16 (Peace, Justice and Strong Institutions) by creating a safe and stable environment, conducive to education and research. In addition, international partnerships in this area are in line with SDG 17 (Partnerships for the Goals), using global expertise and resources to strengthen the security and well-being of the university community. Through this multifaceted approach, safety and psychological well-being remain a priority, ensuring that education and science continue even in times of crisis and uncertainty.

SUPPORT FOR DISPLACED TEACHERS AND STUDENTS

Universities must adapt quickly to support displaced teachers and students, providing them with uninterrupted access to educational and research opportunities. Important measures include the expansion of online learning platforms, the provision of temporary housing, and the creation of specialized support services to address the unique challenges, faced by displaced persons.

The state plays a key role in this process by developing policies that facilitate the academic transition for displaced persons, such as the recognition of educational credits and qualifications. The state can also provide financial and organizational support to universities to meet the needs of displaced students and academic staff.

At the international level, the development of partnerships with other universities and educational organizations around the world can open up additional opportunities for displaced academic staff and students wishing to continue their education and scientific activities abroad. These partnerships may include scholarships, research grants, and exchange programs that allow displaced members of the Ukrainian academic community to continue their professional activities.

Supporting displaced academic staff and students directly contributes to SDG 4 (Quality Education) by ensuring access to high-quality educational opportunities for all, regardless of their status. Public policies that promote the recognition of credits and qualifications for displaced people also contribute to the achievement of SDG 10 (Reducing Inequalities) by removing barriers to education and research. In addition, the financial and organizational support of universities for the integration of displaced people is aligned with SDG 11 (Sustainable Cities and Communities), transforming educational institutions into inclusive spaces for all.

REJUVENATION OF SCIENCE AND SUPPORT OF YOUNG SCIENTISTS

Attracting young scientists to research and innovation is critical for universities. Through mentoring programs, improving access to research funding and creating opportunities for young researchers to lead projects, more active participation of young people in scientific activities can be achieved.

It is also important to involve young scientists in decision-making processes, ensuring that their ideas and views shape the direction of scientific research.

The state should support these processes by investing in programs specifically designed for young researchers, including the provision of grants, the creation of research incubators and the development of policies that stimulate entrepreneurship and innovation among young people.

At the international level, the cooperation of young Ukrainian scientists with their colleagues around the world can provide opportunities for young Ukrainian scientists to participate in joint research projects, conferences and seminars, supporting their professional growth and integration into the global scientific community.

This involvement of young scientists directly contributes to the implementation of SDG 4 (Quality Education) of the UN by providing quality education and research opportunities. Initiatives to increase the participation of young scientists in project management and decision-making also contribute to SDG 5 (Gender Equality), ensuring equal opportunities for all young researchers, regardless of gender. Public investment in youth-focused programs and the promotion of entrepreneurship and innovation support SDG 8 (Decent Work and Economic Growth) by contributing to job creation and economic development. In addition, international cooperation in the framework of supporting young scientists contributes to SDG 17 (Partnership for the Achievement of Goals), strengthening global integration and exchange of knowledge necessary for the modernization of Ukrainian science.

FINANCIAL SUPPORT AND STABILIZATION

To ensure the financial stability and sustainability of research initiatives and academic programs, universities need to actively seek various sources of funding. Developing partnerships with industry to fund applied research and organizing alumni fundraising to support scholarship programs and infrastructure upgrades are examples of effective strategies.

Government support should be aimed at ensuring adequate funding of science and higher education, in particular through regular indexation of wages in response to economic conditions. The introduction of tax incentives for enterprises investing in research and development can stimulate the contribution of the private sector to scientific activities.

Involvement of international financial organizations, philanthropic institutions and foreign governments in the financing of Ukrainian science can play a key role in supporting large research projects and infrastructure development, which is important for the global integration of Ukrainian scientific efforts.

The combination of various financial sources and the involvement of both state and international resources not only contribute to the implementation of the UN Sustainable Development Goals, in particular SDG 4 (Quality Education) and SDG 17 (Partnership to Achieve the Goals), but also ensure the long-term stability and development of the academic community. The government's prioritization of research funding and salary indexation contributes to the achievement of Development Goal 8 (Decent Work and Economic Growth) by strengthening financial stability among the academic workforce. Tax incentives for private sector R&D investment are aligned with SDG 9 (Industry, Innovation and Infrastructure), encouraging technological progress and industry involvement.

STRENGTHENING OF SOCIAL PROTECTION

Universities should implement comprehensive welfare programs for their communities, including health insurance, pensions and housing support. The creation of emergency funds to support members of the academic community in crisis situations is also important to ensure stability.

The state must play a key role by developing policies that guarantee reliable social protection for the academic community, ensuring stable employment contracts and adequate pensions. Legislative measures to protect the rights and well-being of scientists, especially in conflict-affected regions, are crucial.

Cooperation with international organizations can provide additional resources and expertise in the creation of social protection programs. This may include technical assistance and access to specialized international social funds to support academic communities in times of crisis.

Strengthening social protection in academic institutions is in line with SDG 1 (No Poverty) and SDG 10 (Reduced Inequality), ensuring financial security and equitable support for all members of the community, including those in conflict zones. It also contributes to the achievement of SDG 3 (Good Health and Well-being) through the protection of health and well-being, which is an important aspect of social protection. State initiatives for stable contracts and adequate pensions support SDG 8 (Decent Work and Economic Growth) by promoting a safe and supportive working environment. International cooperation underpins SDG 17 (Partnerships for the Goals) by expanding global support and cooperation.

WORKFLOW OPTIMIZATION AND WORK-LIFE BALANCE

Universities should support flexible working arrangements, such as telecommuting and flexible hours, to meet the needs of their staff and students. Encouraging a culture that values work-life balance, particularly through the provision of early childhood education facilities on campus and the support of cultural events is also important.

The government should promote the optimization of work processes in academia, reducing bureaucratic obstacles and supporting an inclusive environment for research and innovation. This could include streamlining grant application procedures and reducing the administrative burden on academic staff.

Studying international best practices for managing academic workloads and ensuring work-life balance can provide valuable insights. Partnerships with foreign universities and research institutions can facilitate the exchange of knowledge about effective work policies and initiatives, aimed at improving the well-being of the university community.

Optimizing the workflow and ensuring work-life balance in universities play a key role in achieving SDG 3 (Good Health and Well-being), ensuring the well-being of the academic community. Also, supporting the creation of a flexible and supportive work environment is in line with SDG 5 (Gender Equality), especially useful for women who often juggle multiple roles. Government measures to simplify bureaucratic processes contribute to SDG 8 (Decent Work and Economic Growth) by increasing productivity and job satisfaction. International cooperation in these areas reinforces SDG 17 (Partnerships for the Goals), using global experience to improve the quality of academic life.

MOTIVATION AND RECOGNITION PROGRAMS

For the development of a prosperous institutional ecosystem in Ukraine, it is important to implement motivation and recognition programs. At the university level, it is important to introduce programs that identify and celebrate the achievements of researchers and teachers. These programs may include awards for outstanding research contributions and recognition of innovative teaching methods. The state should play a key role in supporting these initiatives, perhaps through national awards and grants, aimed at honoring scientific excellence. It is also important to create a policy framework to ensure sustainable funding for these recognition programs. At the international level, Ukrainian scientists should be encouraged and supported to participate in global awards and recognition platforms, improving the visibility of Ukraine's scientific achievements on the world stage. This approach is in line with SDG 9 (Industry, Innovation and Infrastructure) and contributes to the creation of an environment that values and rewards innovation and research.

PROMOTION OF ACADEMIC FREEDOM

Promoting academic freedom is fundamental to the development of science and education. Universities must become bastions of free inquiry, where scholars and students can explore, debate and innovate without fear of censorship or repression. This requires a robust institutional ecosystem that protects academic freedom, as well as active advocacy for its importance. At the state level, legislation that guarantees these freedoms and protects academic staff from unfair interference is critical. Such policies are not only in line with SDG 16 (Peace, Justice and Strong Institutions), but also ensure the creation of an enabling environment for innovative research. At the international level, the development of partnerships with global academic networks can provide additional support and solidarity, ensuring that Ukrainian science remains connected to the global scientific community and adheres to the principles of free and open research.

CULTIVATION OF LEADERSHIP AND THE THIRD MISSION

Fulfilling the third mission of universities involves expanding their role in society through engagement, innovation, and solving societal problems. This requires cultivating leadership in the academic community capable of guiding institutions toward these broader challenges. Universities should develop leadership qualities among their members, encouraging them to take on roles that go beyond traditional academic boundaries. At the national level, policies and funding mechanisms can support universities in implementing projects that benefit the wider community, including technology transfer initiatives, community service programs and public policy development. This approach is consistent with SDG 11 (Sustainable Cities and Communities) and SDG 17 (Partnerships

for the Goals), emphasizing the role of academic institutions as engines of social progress and innovation. At the international level, cooperation with institutions that have successfully integrated the third mission can provide valuable information and structures that increase the capacity of Ukrainian universities to contribute to the development and recovery of society.

INFRASTRUCTURE RECOVERY AND TECHNOLOGICAL PROGRESS

The revival of Ukrainian education and science involves a major focus on the restoration of damaged infrastructure and the integration of technological advances. At the university level, this includes assessing the current state of physical infrastructure, determining priorities for its reconstruction and modernization, as well as updating laboratory equipment, improving digital infrastructure, and ensuring that universities are able to support cutting-edge scientific research. The state plays a key role in allocating resources for these projects and creating policies that facilitate their rapid and effective implementation. The involvement of international partnerships can bring additional expertise and funding, contributing to the implementation of global best practices in infrastructure development. This is in line with SDG 9 (Industry, Innovation and Infrastructure) and is critical to restoring an enabling environment for research and innovation, laying the foundations for scientific breakthroughs and economic development.

COMMUNITY ENGAGEMENT AND IMPROVED COMMUNICATION

Strengthening community engagement and communication within the institutional ecosystem is key to fostering a culture of collaboration and public trust in higher education and science. Universities should take the lead in establishing outreach programs that connect the academic community with the wider society. This can include public lectures, science festivals and open labs that not only demystify science but also encourage the public to participate in scientific discussions. At the government level, policy support that promotes science communication and public engagement is needed to enhance the impact of these initiatives. At the international level, networking with global academic communities can improve the exchange of ideas and best practices. This strategic focus supports SDG 11 (Sustainable Cities and Communities) and SDG 17 (Partnerships for the Goals), emphasizing the role of higher education and science in societal development and making public more informed and engaged.

PROMOTION OF INNOVATIVE ENTREPRENEURSHIP

Fostering innovative entrepreneurship is vital to ensuring the sustainability and growth of the academic sector. Universities should nurture an entrepreneurial spirit among researchers and

students by providing access to business incubators, mentoring programs and seed funding for startups. These initiatives encourage the translation of scientific discoveries into marketable products and services, stimulating economic growth and innovation. At the state level, creating a favorable regulatory and financial environment for startups and innovative enterprises is critically important. This includes simplifying the process of setting up new businesses, providing tax incentives and facilitating access to capital. Engaging with international networks of innovators and entrepreneurs can also open opportunities for collaboration, investment and market expansion. In line with SDG 8 (Decent Work and Economic Growth) and SDG 9 (Industry, Innovation and Infrastructure), this element emphasizes the importance of turning scientific research into practical application, contributing to a vibrant ecosystem of innovation and entrepreneurship in Ukraine.

CREATION OF ECOSYSTEMS FOR SUSTAINABLE SCIENTIFIC ACTIVITY

The creation of ecosystems that support sustainable educational and scientific activity is an integral part of the long-term development of the system of higher education and science. At the institutional level, this involves fostering interdisciplinary collaboration and creating platforms that encourage the cross-pollination of ideas between different scientific disciplines. This can be achieved by establishing collaborative research centers and innovation hubs that bring together the academic community, industry professionals and government representatives. The role of the state is to provide regulatory frameworks and financial support that encourage such ecosystems, including incentives for collaboration between industry and academia. At the international level, integration into global research networks and innovation ecosystems offers the Ukrainian academic community access to wider resources, expertise and opportunities for collaboration, facilitating its participation in solving global challenges. This strategic focus aligns with SDG 17 (Partnerships for the Goals), increasing the potential for joint problem-solving and innovation.

CREATION OF A BARRIER-FREE ENVIRONMENT

Ensuring accessibility and inclusiveness in the academic community is critical to maximizing the intellectual potential of human capital. Universities must lead by example by implementing policies and changing infrastructure to make campuses and research facilities accessible to people with disabilities and foster an inclusive culture that values diversity. At the national level, the government should adopt and enforce legislation that guarantees equal opportunities in education and employment in the scientific sector by removing physical, social and economic barriers. The engagement with international disability rights and inclusion advocates can provide additional information and support to create a barrier-free environment. This initiative is closely linked to SDG 10 (Reduced Inequality), emphasizing the importance of inclusiveness in building a strong academic community.

OPEN SCIENCE

The introduction of open scientific practices is fundamental to increasing transparency, reproducibility and collaboration in research. At the institutional level, universities can facilitate this transition by adopting open access policies for research results, investing in open data repositories, and providing training in open science practices. The role of government is critical in creating a policy environment that requires and supports open access to publicly funded research, ensuring free access to scientific knowledge. In the international arena, participation in global open science initiatives and platforms can help integrate Ukrainian research into the global knowledge base, contributing to wider dissemination and cooperation. This approach supports SDG 9 (Industry, Innovation and Infrastructure), which encourages innovation and access to information, and Goal 16 (Peace, Justice and Strong Institutions), promoting transparency and accountability in research.

DIGITAL INFRASTRUCTURE FOR REMOTE COLLABORATION

Developing a reliable digital infrastructure is key to supporting remote collaboration and ensuring the continuity of scientific research, especially in times of war. At the university level, this requires the implementation of advanced digital platforms that facilitate continuous communication, data sharing and collaborative research, regardless of geographical limitations. The digital transition must be accompanied by educational programs for staff and students, aimed at improving digital literacy and optimal use of these tools. An important transformative role in this process is played by the state, which can invest in national broadband initiatives and ensure secure, high-speed Internet access for all research institutions. In addition, policies supporting digitization of scholarly communication and collaboration are important. At the international level, the integration of Ukrainian science into global digital research networks can contribute to international cooperation, access to global databases and participation in international research projects. This initiative is in line with SDG 9 (Industry, Innovation and Infrastructure) and contributes to the creation of sustainable infrastructure that enables inclusive and sustainable industrialization.

SUSTAINABLE PRACTICES IN SCIENTIFIC RESEARCH

The implementation of sustainable practices in scientific research is aimed at achieving two goals: the development of science and the preservation of the environment. Universities should integrate the principles of sustainable development into research methodology, promoting the use of renewable resources and minimizing waste in laboratories. This may include applying the principles of environmental chemistry, implementing energy-efficient technologies, and developing sustainable research projects. Government involvement is critical in setting environmental standards for

scientific research, providing incentives for sustainable practices, and funding research in sustainability science. At the international level, participation in global sustainable development initiatives can increase the visibility and impact of Ukrainian research in this important area. Such efforts are directly linked to SDG 13 (Climate Action), which incentivizes urgent action to combat climate change and its impacts, and to SDG 12 (Responsible Consumption and Production), promoting sustainable consumption and production patterns.

KNOWLEDGE AND TECHNOLOGY TRANSFER OFFICES

Knowledge and Technology Transfer Offices (KTTOs) play a key role in bridging the gap between scientific research and practical application, stimulating innovation and economic growth. At the institutional level, universities should establish or strengthen KTTOs to promote commercialization of research results, protect intellectual property, and facilitate partnerships with industry. The state can support this process by ensuring clear regulation of intellectual property rights, offering financial incentives for technology transfer, and fostering an entrepreneurial ecosystem. At the international level, cooperation with foreign KTTOs and innovation centers can provide insight into best practices, increase the global competitiveness of Ukrainian innovations, and open international markets for technological products and services. This element supports SDG 9 (Industry, Innovation and Infrastructure) by promoting innovation and sustainable industrialisation.

Summarizing the analysis of 18 strategic elements, evenly distributed between human-centric and infrastructural categories, a comprehensive roadmap for the reboot of Ukrainian science is proposed (**Fig. 1.3**). Deeply aligned with the triple helix model, this roadmap emphasizes collaborative interactions between academia, industry and government as the cornerstone of a sustainable and dynamic scientific ecosystem. Integrating these elements within the framework of the triple helix model, Ukraine begins the path not only to the revival of its academic landscape, but also to rethinking its role on the global stage.

This holistic approach ensures that the reboot of Ukrainian higher education and science is not just recovery, but also ensuring competitiveness. The people-centred elements of the strategy emphasize the importance of developing talent, promoting inclusiveness and protecting the rights and well-being of people in the academic environment. These efforts are critical to cultivating a vibrant and diverse institutional environment that supports values, equality and human rights. At the same time, the infrastructure elements focus on creating the physical and conceptual foundations necessary for advanced research, international cooperation and sustainable development.

In addition, such a strategic approach is key to the development of science-intensive industries critical to the defense capability and stability of the state's economy. Emphasis on innovation and technology transfer, backed by the commitment to environmental practices, makes Ukraine a visible player in solving global challenges while strengthening its national security and economic independence.

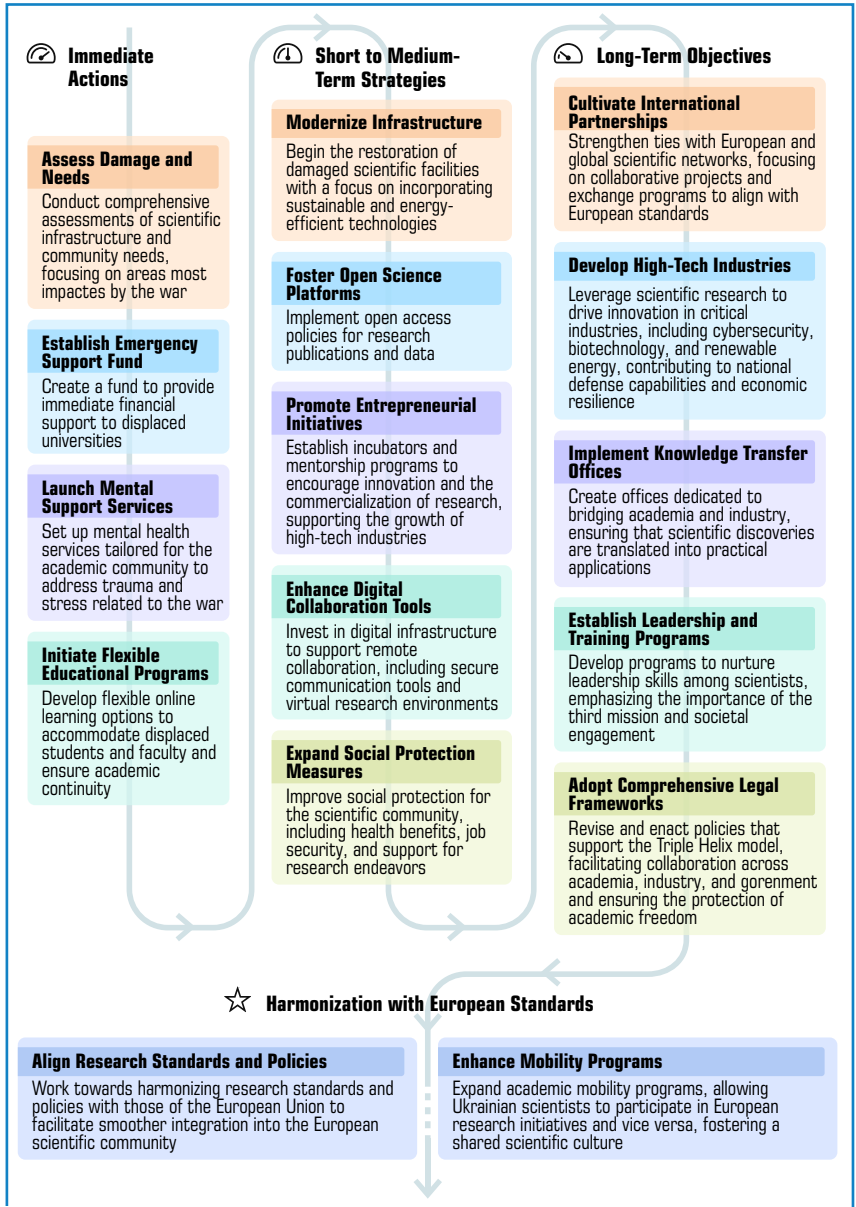

Fig. 1.3 Roadmap for building the institutional ecosystem to preserve academic potential

The harmonization of scientific policy and practice of Ukraine with European standards is a thoughtful and strategic aspect of this plan, which ensures alignment with the European academic community. Such agreement is important for Ukraine's aspirations to integrate more fully into the European Union, celebrating its identity as a free, independent and self-sufficient state based on the principles of democracy.

In summary, the strategic objectives of building an institutional ecosystem based on the harmonization of people-centric and infrastructural elements with the triple helix model are a visionary plan for the future. It embodies the aspirations of a nation ready for transformation, innovation and leadership. Thanks to joint efforts between academia, industry and government, as well as implementing the values of inclusiveness, sustainability and international cooperation, Ukraine is on the path to transforming the system of higher education and science. This transformation will contribute to stability during martial law, post-war reconstruction and the country's integration into the European Union.

1.8 CONCLUSIONS

Preservation of academic potential is recognized as one of the key problems in the field of scientific research in Ukraine. Therefore, it is necessary to integrate higher education, science, technology and innovation into the country's future development strategy, ensure systemic reforms, and preserve and develop intellectual potential by providing the necessary resources and supporting networks and partnerships.

The study of the influence of socio-economic, socio-psychological, professional and personal factors on the academic community of higher education institutions in the conditions of the ongoing war emphasizes the significant influence of these factors on the ability to preserve and develop academic potential. Understanding these relationships opens up an opportunity to develop effective strategies for supporting educational and scientific activities and ensuring the stability of academic potential in crisis conditions.

The results of the study indicate the need for an integrated approach that includes security strategies, investments in physical infrastructure, social protection and flexible conditions for the academic community. Special attention should be paid to psychological support and adaptation of academic staff.

Against the background of the ongoing war, the challenges related to the preservation of academic potential, caused by the constant destruction of infrastructure, the lack of an opportunity to ensure physical security, as well as the need to finance defense, are extremely difficult. In addition, the potential "brain drain" and reduction in the quality of research can significantly reduce the country's academic potential, which will negatively affect its image and complicate the process of post-war recovery and integration into the global scientific space.

Given these challenges, the preservation and development of Ukraine's academic potential remain high-priority tasks that require the coordinated efforts of the government, scientific

institutions, and the active involvement of the international community. The priority areas are ensuring physical security, adapting infrastructure to military conditions, supporting innovative research and international cooperation.

International support and the mobilization of funding and technological resources are key to meeting the challenges of the war. In addition, it is important to work on creating favorable conditions for the return of scientists and the involvement of young people in scientific activities in order to prevent the loss of academic potential and ensure a sustainable future of Ukraine.

Based on the analysis of the current situation and the proposed roadmap of the institutional ecosystem, a comprehensive action plan has been developed to preserve the academic potential, which harmonizes European standards, supports the development of high-tech industries and lays the foundation for Ukraine's accession to the European Union. This strategic approach will allow Ukraine not only to overcome pressing challenges, but also to pave the way for a future where its academic community is competitive, inclusive and able to make a significant contribution to nation building and the global quest for knowledge.

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