FACTORS OF FORMATION AND FUNCTIONING OF EFFECTIVE MODELS OF UNIVERSITY DEVELOPMENT BASED ON THE PRINCIPLES OF SUSTAINABILITY

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Abstract. The article examines the factors that determine the formation and functioning of effective university development models based on the principles of sustainability. The subject of the study is a set of conditions and determinants that influence the ability of higher education institutions to integrate the principles of sustainable development into their educational. scientific, managerial and social activities. The author's approach is based on the fact that universities in modern conditions cannot be limited only to the implementation of the classical educational and scientific mission, but must act as agents of sustainable transformations in society, forming a new culture of responsibility - environmental, social and economic. The research methodology is based on a systemic and comprehensive analysis, which includes elements of institutional analysis, comparison of best international practices, as well as generalization of modern approaches to managing the development of universities in the context of sustainability. Particular attention is paid to the distinction between two groups of factors – those that determine the formation of sustainable development models and those that ensure their functioning. Such a division allows you to avoid duplication of elements and form a clear structural basis for assessing the effectiveness of university development strategies. The purpose of the study is to identify, classify and substantiate key factors that form and support effective university development models in accordance with the principles of sustainability. Findings: The forming factors include regulatory, strategic, financial and economic, scientific and educational potential, innovative and social. The functioning factors include management, resource provision, quality, partnership and network interaction, digitalization and monitoring aspects. Effective university development models can be achieved only if

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both groups of factors are balanced. The forming factors create strategic and resource prerequisites for sustainable transformations, while the functioning factors ensure the practical implementation, monitoring and continuous improvement of the selected model. The formation of effective models of sustainable university development is determined by regulatory and legal support, a clear mission and strategic guidelines, the availability of financial and economic resources, scientific and educational potential and the development of innovative infrastructure. The functioning of such models requires a mature system of institutional management, stable sources of funding, a high-quality and interdisciplinary educational process, developed partnerships and networking, active digitalization, and regular monitoring of results.

1. Introduction

Current conditions for the functioning of higher education institutions (HEIs) in Ukraine are characterized by high instability of the geopolitical and economic environment. The unfavorable security situation leads to social tension in society, which affects conditions and efficiency of the HEIs functioning. The context of a full-scale war has led to the emergence of imbalances and integration challenges for the national higher education system as a whole.

Given the duration and intensity of hostilities in Ukraine, higher education institutions are faced with a number of important problematic aspects, among which, first, we can single out the destruction of infrastructure, financial instability and limited autonomy of institutions, imperfect management and regulatory framework, problems of education quality and academic integrity, demographic decline and migration, which affect the quality of functioning of higher education institutions and the entire higher education system. Therefore, the issues of studying structural changes in the national higher education system, identifying factors of formation and functioning of effective models of the university development according sustainability principles are becoming more relevant.

The works of such domestic scientists as: V. Andrushchenko, L. Antoshkina, S. Bebko, T. Vlasyuk, I. Hryshchenko, I. Zhylyaev, S. Zakharin, I. Kalenyuk, V. Kremen, V. Lugovyi, L. Shevchenko, etc. are devoted to solving the problems of functioning of higher education

institutions. The issues of development of higher education institutions in the context of sustainable development and digital transformation are the subject of scientific research of the below-mentioned scientists: O. Bazelyuk, N. Gavkalova, V. Geyets, I. Hryshchenko, I. Kalenyuk, V. Kremen, O. Lyashenko, O. Naydenov, O. Totska, L. Tsymbal, Z. Shatska P, etc. However, research into the factors of formation and functioning of effective models of higher education institutions taking into account the sustainable development principles require more detailed consideration, taking into account the economic and security situation in the country and transformation processes.

The purpose of the study is to identify, classify and substantiate key factors that form and support effective university development models in accordance with the principles of sustainability. The research methodology is based on a systemic and comprehensive analysis, which includes elements of institutional analysis, comparison of best international practices, as well as generalization of modern approaches to managing the development of universities in the context of sustainability.

2. Challenges of the development of Ukrainian higher education institutions

Security and economic conditions in which higher education institutions in Ukraine operate today put forward an urgent need to implement new models of transformation and modernization of their activities. In this context, the orientation towards the sustainable development principles, which encompass economic, environmental and social components, is of particular importance. The beginning of Russia's full-scale armed aggression against Ukraine has radically changed conditions for the existence of the higher education system, as universities have found themselves facing a double challenge, including: the need to adapt the educational process to new realities and functioning in conditions of constant security threat.

The war caused significant destruction of the material and technical base, i.e.: the infrastructure of almost sixty universities was damaged or partially destroyed, some of which were forced to relocate to relatively safe regions. This limited educational capacities and led to massive transition to distance learning. Although digital formats ensured the continuity of education, for

a number of specialties – primarily engineering and medicine – they turned out to be insufficiently effective, which exacerbated the problem of the quality of specialist training.

The impact of the war on the human resources potential of universities was no less noticeable. A significant number of teachers and staff were forced to evacuate both within the country and abroad. A certain part of scientific and pedagogical workers joined the ranks of the Armed Forces of Ukraine. This situation led to the need for operational restructuring of educational and scientific programs, as well as to the search for new approaches to distributing the workload among the personnel who remained to work.

Financial instability has also become a serious challenge. The destruction of infrastructure and the outflow of personnel, as well as the need for state reallocation of resources for defense and humanitarian needs, have led to a decrease in the autonomy level of higher education institutions. State-owned universities have lost 10-20 % of financial revenues, which has affected both their ability to support their own development and their ability to invest in the modernization of educational programs or research activities. An additional problem is that budget institutions are limited in the use of income and do not have full freedom in the disposal of grant funds, which could become a resource for innovative changes.

In response to these challenges, the Ministry of Education and Science of Ukraine initiated a number of systemic reforms. The key direction was the optimization of the merger of specialized universities to increase their sustainability and competitiveness. The implementation of these measures at the national level allows not only to use budget resources more effectively, but also to create prerequisites for the integration of domestic universities into the European scientific and educational space, formation of new management strategies and ensuring the highest quality of training for students in the conditions of war and post-war reconstruction.

Transformation processes in the higher education in Ukraine are caused by both the complex internal socio-economic and security situation, and orientation of the state towards the European vector of development. In modern conditions, this requires not only the adjustment of management approaches, but also a deep reform of the regulatory framework, which should become the basis for creating effective models of university functioning based on the sustainability principles [2]. At the same time, the current regulatory field in many higher education institutions is largely outdated and often does not meet the requirements of today, which generates excessive regulation in matters of the personnel policy and financial management [8-9]. As a result, operational management mechanisms are not sufficiently effective, which negatively affects the adaptability level of universities and reduces their competitiveness both at the national and international levels.

European integration puts forward new standards aimed at improving the quality of the educational process, which must be guaranteed both at the level of higher education students and at the level of scientific and pedagogical personnel. In this context, the key factor is ensuring academic integrity, which serves as the foundation for sustainable development of the education system. Violations of the principles of honesty, transparency and equality of opportunities, in particular manifestations of corruption, remain a serious obstacle to strengthening competitiveness of domestic universities in the global market of educational services. Overcoming this barrier is one of the basic tasks in formation of effective models of development of higher education institutions.

3. Factors influencing the sustainable development of universities in wartime

Functioning of the national higher education system is significantly affected by demographic factors directly related to military events. Military actions have caused a decrease in the birth rate, a high mortality rate, and large-scale forced migration, as a result of which the population of Ukraine has significantly decreased. In the long term, these processes lead to the aging of the nation and a narrowing of the contingent of potential students. Under these conditions, the number of graduates of general secondary education institutions decreases every year, which directly affects the enrollment in universities. This requires taking into account the cyclical nature of demographic fluctuations in the state policy regarding regulation of the network of higher education institutions; optimizing the number of universities and their rational distribution should be the key to increase the efficiency of the entire higher education system.

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A factor that directly affects formation of sustainable models of the university development is also challenges of the digital transformation of the educational process. The forced introduction of distance education, first due to the COVID -19 pandemic, and later due to military operations in Ukraine, revealed insufficient readiness of the educational infrastructure to work in conditions of complete online dependence. A significant part of universities did not have the appropriate software, and individual teachers and higher education students did not have a sufficient level of digital competencies to ensure a high-quality educational process. The lack of unified standards and methodological recommendations for organization of distance learning exacerbated this problem, complicating both the management decisions of university management and the learning process for students.

An equally important factor is the psycho-emotional consequences of war, which significantly affect the productivity of educational activities. For students and staff of higher education institutions located in temporarily occupied territories or in regions where active hostilities are ongoing, the educational process is accompanied by constant stress and uncertainty. This creates additional barriers to obtaining a quality education and requires universities to develop new supportive practices aimed at preserving mental health and increasing stress resistance of participants in the educational process.

Regulatory, demographic, and technological factors, complemented by the impact of war realities, form a complex field of challenges for higher education institutions. Overcoming these challenges is a crucial condition for building effective models of the HEI development based on the sustainability principles, based on innovation, flexibility, and social responsibility.

Let us analyze some statistical indicators that characterize the activities of domestic higher education institutions under martial law. If we consider the dynamics of the number of these institutions for the period 2021/22-2024/25 academic years, we can conclude that since the 2022/23 academic year, the number of universities has decreased, which is explained by the unfavorable security situation in the country and the occupation of part of the country's territories (Figure 1).

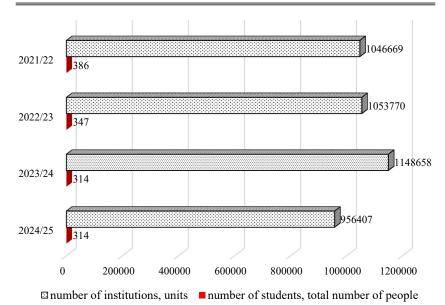


Figure 1. Dynamics of the number of higher education institutions and the number of students in Ukraine

Source: summarized by the author based on [7]

Despite the decrease in the number of universities, the number of higher education students in the 2022/23 and 2023/24 academic years increased, which is explained by the increase in the number of graduates and the ability to receive educational services from any location, which allows distance learning. In the 2024/25 academic year, the number of university students decreased by 16.73% compared to the previous year. This was influenced by a number of reasons, namely: a decrease in the total number of students and an increase in the number of young people who left to study in other countries due to the security situation in Ukraine.

The trend towards a decrease in the number of higher education institutions should also be analyzed in terms of their forms of ownership (Figure 3). Thus, despite the overall decrease in the number of higher education institutions in the 2024/25 academic year, the number of private institutions increased during this period (by 10 units). Also, in the

2024/25 academic year, the number of municipal institutions increased by one unit compared to the 2023/24 academic year. The overall decrease in the number of higher education institutions in the 2024/25 academic year compared to the 2021/22 academic year was 72 units.

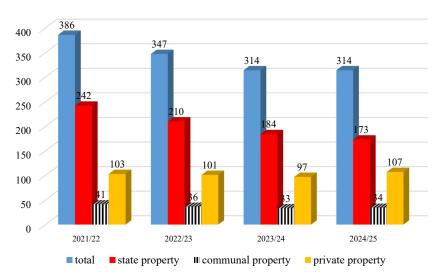


Figure 2. Distribution of higher education institutions in Ukraine by the ownership form (units)

Source: summarized by the author based on [7]

Despite the extremely difficult conditions of functioning of domestic higher education institutions, most of them demonstrate a desire to gradually improve their own development models. This process directly contributes to the competitiveness growth of universities not only in the national but also in the international market of educational services. The SWOT analysis made it possible to identify a number of strengths that determine the potential of Ukrainian universities in the modern globalized world, taking into account the context of full-scale war, digital transformation of educational institutions and intentions of Ukraine for the European integration.

Among the key advantages, it is worth noting the high professional level of scientific and pedagogical workers, focused on preservation and

development of fundamental educational traditions in combination with modern trends in world science. An important resource are scientific schools, which successfully support the continuity of scientific traditions of outstanding scientists, while integrating the latest scientific ideas and innovative approaches [4]. Recent years have also witnessed the intensification of academic mobility of teachers and higher education students within the international programs Erasmus+, DAAD, Horizon Europe and other projects, which significantly strengthens the integration of Ukrainian education into the European and global scientific and educational space. An additional strength is the extensive network of universities of various levels of accreditation, which guarantees wide access to higher education, contributes to the implementation of the principle of inclusiveness and increases the overall educational potential of the state [1].

At the same time, the SWOT analysis revealed a number of weaknesses that significantly hinder the development of universities and reduce their competitiveness in comparison with leading foreign higher education institutions. The most significant problem remains the insufficient level of funding, which directly limits the opportunities for modernization of the material and technical base, investments in development of digital infrastructure and creation of a comfortable educational environment. A significant risk that negatively affects the image of universities is corruption, including violations of the principles of academic integrity and bribery, which significantly reduces trust among both Ukrainian students and foreign students.

Another weakness is the insufficient dynamics of updating educational programs. Often, curricula do not meet the current needs of the labor market and requirements of the modern business environment, which is characterized by high variability and requires new skills from specialists. The lack of the effective mechanism for predicting future professions leads to the imbalance, namely: the labor market is oversaturated with specialists of certain profiles, while a number of promising and popular areas remain without proper staffing. Particularly critical is the fact that training new specialists in scarce industries requires at least four years, which significantly slows down the response of the education system to changes in the national economy.

One of the most serious challenges for formation of effective models of the university development in Ukraine is the mass outflow of the youth from the educational and scientific spheres. The unfavorable security situation caused by the war led to significant migration of youth abroad, which significantly reduced the number of students and reduced the educational potential of the state. A significant part of young people joined the ranks of the Armed Forces of Ukraine and other security structures, which, although it testifies to a high level of civic responsibility, reduces the quantitative and qualitative composition of future specialists. An alarming trend is the constant reduction in the share of young scientists in the general structure of the personnel of higher education institutions. This creates a real threat to the innovative development of both universities and regional educational and scientific systems, and in the broader perspective – to the intellectual and economic progress of the state as a whole.

Crisis phenomena, despite their destructive power, can at the same time serve as a catalyst for transformations and renewal of the education system. A prime example was the COVID-19 pandemic, which highlighted the need for rapid establishment of distance learning forms. Universities were forced to actively implement various online platforms and digital tools, which ensured the continuity of the educational process [5-6]. A similar, albeit larger, challenge arose with the beginning of a full-scale invasion, the occupation of part of the territories and the destruction of the educational infrastructure. In these conditions, distance learning formats became not just an alternative, but the only way to maintain accessible education and ensure the safety of participants in the educational process. This proves that even in crisis conditions, universities can form innovative approaches to the organization of educational activities, which can later be integrated into a sustainable model of their development.

One of the factors strengthening effective models of the university development is the intensification of the education internationalization. Recent years have demonstrated a significant expansion of the scale of international cooperation of Ukrainian higher education institutions with universities in the USA, the European Union, Canada and other countries. International interaction ensures the exchange of experience, improves the quality of educational and scientific programs, promotes the mobility of

teachers and higher education students, and the integration of Ukrainian education into the global scientific and educational space.

Special attention should be paid to the issue of decentralization and expansion of university autonomy, which is recognized as one of the key areas for ensuring their competitiveness and sustainable development [3; 10]. Autonomous universities receive more opportunities for independent formation of educational strategies, mobile response to labor market challenges and implementation of innovative management practices. In combination with internationalization and digitalization, these factors create a solid foundation for building effective models of university functioning that meet modern global sustainability trends.

In current conditions of martial law, one of the key tasks of the higher education system is to ensure support for socially vulnerable groups of the population and create equal opportunities for their access to quality educational services, taking into account specific needs. Every year, the number of people with disabilities is increasing, which creates a requirement for universities to make systemic changes both in the content of the educational process itself and in the organizational mechanisms of its implementation. However, the introduction of these changes requires available appropriate financial basis. In conditions of the state budget deficit, it is impossible to meet relevant needs solely at the expense of budget funds. That is why higher education institutions are forced to actively seek additional resources, in particular by attracting investors, participating in international grant programs, expanding partnerships with charitable organizations, patrons and alumni.

A promising direction in this context is the deepening of the financial autonomy of universities. Granting them broader rights to dispose of their own and attracted financial resources will create conditions for more effective management, increase the investment attractiveness of educational institutions, and contribute to expanding opportunities for ensuring inclusivity and social justice in the field of higher education.

Systematizing the results of the research, we can identify a group of factors for the formation and functioning of effective models of university development based on the principles of sustainability (Figure 3). The first group includes:

- regulatory and legal factors - state standards, educational programs, and international agreements create the basis for integrating environmental,

social, and economic dimensions of sustainability into strategic documents of higher education institutions;

- strategic factors defining the mission, values, and strategic guidelines aimed at social responsibility, environmental safety, and economic efficiency is the basis for building effective development models; awareness of the role of the university as an agent of sustainable change ensures the systematic and long-term effectiveness of its transformations;
- financial and economic factors available financial resources, access to state funding, international grants, investments and partnerships determines the capabilities of universities to establish sustainable development mechanisms; effectiveness of the model largely depends on the diversification degree of sources of funds and the ability to direct them to innovative and socially significant projects;
- factors of scientific and educational potential qualified personnel, reputable scientific schools, and the willingness of students and teachers to join innovative practices form the basis for building models focused on sustainability;
- innovativeness factors available centers of the technology transfer, startup incubators, and sustainable development laboratories creates practical opportunities for implementing strategies;
- social factors demands of society, business, and government agencies determine the priorities for training specialists and influence the content of educational programs; focusing on meeting the needs of stakeholders contributes to the formation of effective models that combine university goals with the requirements of the labor market and the challenges of sustainable development.

Factors for the functioning of effective university development models based on the sustainability principles nelude:

- managerial factors (covering aspects of institutional governance and corporate culture of the university) – functioning of effective models is possible only if there is a transparent, inclusive and balanced management system; corporate culture and institutional structures must ensure sustainble decisions and trust in them from the academic community;
- resource provision factors, which also include mechanisms for financing higher education institutions at the stage of operation, stable and diversified sources of financing are of particular importance; an important

practice is the implementation of the "green economy" principles, i.e. rational use of energy resources and environmentally friendly cost management;

- quality factors effectiveness of the models is determined by the ability to integrate sustainability principles into curricula and programs;
- partnership and networking factors functioning of sustainable development models of universities is significantly enhanced through cooperation with international and national partners (universities, business structures, communities, public organizations, government institutions), which opens up wider opportunities for access to innovative practices, new financial and educational resources, and also promotes the exchange of experience in the sustainability;
- digitalization factors an important factor in sustainable functioning is active implementation of digital technologies (learning management systems, big data, artificial intelligence, electronic analytics tools), which creates opportunities for monitoring results, increasing management efficiency, openness of the educational environment, as well as reducing environmental burden and optimizing resource use;
- monitoring factors regular monitoring of environmental, social and economic indicators allows universities to objectively assess the effectiveness of implemented strategies; available adaptive mechanisms ensure the ability to quickly respond to changes in the external environment, which makes the functioning of sustainable development models of higher education institutions more flexible and viable.

Each higher education institution independently determines the optimal model of its development, based on the existing internal potential, strategic priorities and external operating conditions. The selected models are reflected in the strategic documents of higher education institutions, which serve as the main program guidelines for their activities. It is within the development strategies that key areas, tasks and mechanisms for ensuring the competitiveness and sustainability of universities are determined.

In practice, several groups of strategies are most common. First, the strategies built on the management structure are distinguished. These include corporate strategy, which determines the general course of institutional development, forms the mission, values, long-term goals and directions of partnership. Business strategy is focused on the development of specialized

units and individual areas of activity, ensuring the implementation of measures to increase competitiveness and formation of the flexible mechanism for adapting to external challenges. Operational strategy involves solving short-term tasks, in particular, optimizing the educational process, modernizing the material and technical base, improving teaching methods. Functional strategy focuses on the development of individual functional areas, including human resource management, logistics, information support or digitalization.

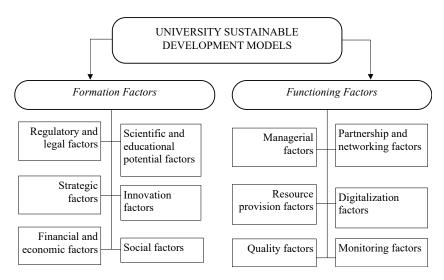


Figure 3. Factors of university sustainable development models formation and functioning

Source: developed by the author

The classification of strategies by functional criterion involves the allocation of a financial strategy aimed at diversifying sources of funding and searching for alternative resources (grants, investments, charitable contributions, government orders). The marketing strategy is responsible for the formation of the positive image of the university, expanding cooperation with employers and attracting students. The organizational strategy is associated with improving the management system, decision-

making, internal regulations, as well as with the digital transformation of administrative procedures. The social strategy covers measures aimed at implementing the principles of academic integrity, inclusion, social responsibility and supporting higher education students and teachers in solving current problems.

A separate group is made up of strategies that take into account the life cycle of the organization. The growth strategy is used by new or dynamic universities that seek to expand educational programs, create new faculties and integrate into the international educational space. The retention strategy is focused on stabilizing positions, maintaining high quality of services and optimizing costs. In times of crisis, a reduction strategy is used, which may involve closing programs that are unpopular with students or restructuring the university.

An important block is competitive strategies. The leader strategy is typical for leading universities that strive to maintain top positions due to innovation, high quality of educational services and active international cooperation. The follower strategy involves adapting to market conditions through testing the successful practices of leading universities. For newly established institutions, the most relevant is the newcomer strategy, focused on active positioning, finding one's own niche and aggressive promotion in the educational services market.

A separate category includes strategies focused on the behavior of stakeholders in the educational services market. The active strategy involves dynamic advancement of the university through innovations, attracting partners and grant resources, while a passive strategy is focused on maintaining the current level of development while minimizing risks.

It is worth emphasizing that in practice, universities are not limited to applying only one type of strategy. Depending on resource capabilities, the state of the external environment and long-term goals, they combine elements of different approaches, forming their own unique institutional development models. In the context of modern challenges accompanied by global transformations, the sustainability principles and digital transformation are at the center of most development strategies of higher education institutions, ensuring their resilience, innovation and competitiveness.

4. Conclusions

Thus, the analysis of the factors of formation and functioning of effective models of the university development according to the sustainability principles allows us to assert that sustainable university development is a multidimensional process that combines regulatory, financial and economic, scientific and educational, innovative and social prerequisites. At the stage of formation, the strategic vision of the university, a clearly defined mission and values, human resources potential and readiness to create the innovative infrastructure are of key importance. The functioning of the outlined models assumes institutionally mature management, stable financing mechanisms, orientation on the quality of the educational process and the development of partner networks.

The sustainable university models are ensured by digitalization, technological modernization, as well as constant monitoring of results and the ability to adapt to dynamic changes in the exogenous environment. The combination of these factors allows higher education institutions to effectively integrate the principles of sustainable development into educational, scientific and organizational activities, forming a new quality of their functioning. Universities that systematically combine internal resources and external opportunities can become key agents of sustainable change in society.

Prospects for further research are related to the development of tools for assessing the effectiveness of the university's sustainable development models, as well as the study of best practices for their implementation in the national and international context.

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