OLEKSII KOSTENKO, YURIY YEKHANUROV

DIGITAL TRANSFORMATION IN UKRAINE: AI, METAVERSE, AND SOCIETY 5.0

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Scientific Approbation

MONOGRAPH

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Abstract: This monograph examines the intricate dynamics of Ukraine's digital transformation, focusing on the intersections of artificial intelligence, the metaverse, and Society 5.0. It offers a comprehensive analysis of how emerging technologies are redefining societal structures, governance frameworks, and human identity in the context of global digitalization. By addressing the multifaceted nature of technological advancements, the research delves into philosophical, legal, and ethical considerations tied to digital identity and the evolving concept of electronic jurisdiction, particularly in the regulation of virtual environments and cyberspaces. Key themes include the implications of immersive technologies for human interaction, the ethical dilemmas surrounding digital avatars, and the role of simulacra in hybrid warfare strategies. Additionally, the study explores the transformative potential of Industry 5.0 in Ukraine's economic and industrial revitalization, emphasizing the integration of digital ecosystems into post-quantum civilization. It underscores the need for interdisciplinary collaboration to tackle challenges associated with technological disruptions while fostering a sustainable balance between innovation and societal well-being. This work contributes to ongoing discourse on the role of digital technologies in shaping future societies, offering a unique perspective on their application and governance in Ukraine's journey toward a digitally empowered society.
Keywords: Digital Transformation, Ukraine, Artificial Intelligence, Metaverse, Society 5.0, Electronic Jurisdiction, Digital Identity, Industry 5.0, Simulacra, Post-Quantum Civilization, Immersive Environments, Ethical Challenges

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THE RIGHT TO PEACE AS A FUNDAMENTAL PRINCIPLE OF THE POST-WAR LEGAL SYSTEM OF UKRAINE

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Currently, national legal doctrines are called to develop effective mechanisms for the protection and effective functioning of national legal systems, taking into account the political realities of the 21st century. All the problematic issues listed above in the conditions of today's challenges need answers from the doctrinal community, including the system of rights, freedoms and legal interests of a person in both the theoretical and practical plane. In particular, we would like to offer for discussion the context of the established system of human rights, which will be discussed further. Many questions arise among scientific legal problems, related to martial law, which was introduced in connection with full-scale invasion of the Russian Federation in Ukraine, as well as the problem that oriented to the period of peacebuilding. We will immediately emphasize that it is not enough "categorically", "unconditionally" distinguish the above-mentioned directions in the near future.

In the given context, it becomes clear that the corresponding load falls, first of all, on the legal system that guarantees human rights, as well as on the state, which should provide them, and the judicial system, which has them in good faith advocate and defend. The legal system of a particular society, which reflects its social economic, political and cultural distinctiveness, is national legal system It determines the integrity of this legal system, reflects unity society, and is one of the manifestations of state sovereignty, an indicator of sustainability legal development. Scientists note that the national legal system determines the peculiarity of the legal life of a certain society. So, it is quite clear that the legal system as the embodiment of the corresponding the achieved level of development of law must be capable of: a) execution certain tasks; b) reproduction necessary in given spatio-temporal dimensions functions; c) ensuring the necessary conditions for an effective legal system regulation.

First of all, we will consider some of the urgent tasks of the modern stage development of the legal system of Ukraine. Among such tasks, we focus primarily on the human right to peace in this article. Tasks of the legal system in democratic social and legal conditions states are influenced by socio-economic, political and moral, ethno-national factors. At the same time, their social content is growing on strengthening group, intergroup social interaction of people about realization of their interests. The specified functions are designed to ensure the existence, well-

being, and sometimes the survival of society itself, the realization of rights and freedoms person and citizen.

The following have a significant impact on the functioning of the legal system general social tasks, such as guaranteeing: a) national security, the fight against aggression on the part of the Russian Federation, liquidation of its on sequences, b) social programs aimed at maintenance of health care, social security of the disabled, etc., protection and protection of children's rights; c) scientific forecasting of the development of law, legislation, economy, population growth, creation of new industries production and workplaces, development of relevant forecast plans and material and financial support in the economy, social sphere; d) creation systems of education and health care available to broad sections of the population pension provision, solving other social issues taking into account issues of security of citizens, certain societies, population groups, etc.; e) creation international, state, legal guarantees to prevent the military aggressions and ensuring conditions for peoples to live in peace [1].

Scientific-technical development of the entire civilization. The state supports science, education, culture, uses their results, promotes development and provision intellectual potential of society, guarantees intellectual development of each individual [2]. This determines the possibility of realizing other human rights and freedoms and citizen, provides grounds for concluding that their cancellation is inadmissible or any limitation. Thanks to the recognition of human dignity are recognized as "inviolable and inalienable human rights, due to which they form the basis of any society, as well as justice" [3].

The main task of the legal system for the period of peacebuilding is the proclamation and provision of the human right to peace. In domestic legal literature it is rightly noted that the direct manifestation of the meaning of law is exactly human rights, which objectively act as a measure of law in society, an indicator of its civilization. After all, with the help of rights, a person joins the material and spiritual the welfare of society, to the mechanisms of power, to legal forms of expression of will and realization of own interests. From the level of security of rights to a decisive extent depends on the degree of perfection of the individual himself, his life and health, integrity and security. It is the human dimension of law that is the cornerstone and the starting point of any social transformations in modern democratic one’s realities [4].

It became obvious that it was not enough to "declare" certain important human rights and freedoms. The state (and this is her if not the most important duty) must guarantee their strict fulfilment, and in if necessary - security and protection. Since the rules of justice are basis of social life, the idea of justice needs a corresponding one institutionalization. A person's place in society, his social role largely depends on the scope of rights and freedoms that determine its social opportunities, character life activities, the system of people's connections in society.

In the legal literature, human rights are considered mainly as a systemic phenomenon characterized by a number of signs, among which it is possible the following should be distinguished first of all: 1) openness, which implies an

opportunity expanding both the list of human rights and the content of already existing rights; 2) polystructurality, according to which individual human rights, on the one hand, have their own defined structure, and on the other hand, they are united in certain groups according to the appropriate sign; 3) integrality, which implies organic the relationship and interdependence of human rights, as well as their content rapprochement on the basis of humanism, justice, equality, solidarity, tolerance, etc. By examining the relevant levels or components of the overall system of rights person, scientists traditionally distinguish groups of personal or civil, political, economic, social and cultural human rights. At the same time for in recent years, given the development of relevant technological innovations, legal science significantly strengthened the doctrinal development of the group informational and somatic human rights, which are already fully justified actually received an independent place in the general system of human rights. In addition, human rights are also distinguished on other grounds or criteria, in particular, depending on the time of their occurrence, they are divided into rights first, second, third and fourth generations; depending on the categories of people, to which the rights apply, single out the rights of women, the rights of children, the rights of persons with limited physical properties, etc.; depending on their subject composition individual and collective rights are distinguished; depending on peculiarities of the forms and mechanisms of the state provision of human rights are divided into negative and positive [5].

However, whatever the specific classification of human rights, their core of the general system is traditionally considered the right to life, without due provision and protection of which it is impossible to talk about any other rights and human freedom. At the same time, the realities of today, especially those related to the Russian-the Ukrainian war and the strengthening of international crisis transformations law and order, cause the need to reconsider the last thesis and, accordingly, the definition of a functionally central right in the system of rights a person's right to peace, which in current realities requires the implementation of a thorough theoretical development as an individual human right.

In this connection, the question should acquire great importance related to constitutional modernization, which is impossible without a guarantee of human rights to peace. That is why, obviously, the right to peace must be earned "status of constitutional consolidation". At the same time, the human right to peace in the general system of its rights and freedoms should be considered fundamental a complex right, which, in fact, should be recognized as primary in the hierarchical one structural systems of human rights.

It is clear that the human right to peace must still be developed (elaborated) by modern socio-humanitarian science in general and law doctrine, in particular, with unconditional consideration of the practical component. But, even with a superficial, overview study of the nature of this right is clear and that it (this right) should include protection from aggressive manifestations on the part of other states, especially states sponsoring terrorism, terrorist organizations, terrorist groups; security from use of nuclear weapons, biological, chemical, and other types of mass

weapons damage; protection against any destruction of the civilian population (esp children), destruction of infrastructure, etc.

In the context of the consequences of the full-scale military invasion of the Russian Federation in Ukraine as of December 9, 2022 within the framework of an international conference "Human rights in dark times" was separately emphasized about the killed civilians residents of Ukraine (6,595, including 443 children), missing children (330), children who forcibly taken to Russia (12572), destroyed educational institutions (2719), educational institutions that cannot be restored (332), destroyed kindergartens (776), destroyed health care facilities (1110), destroyed cults buildings (churches, temples, mosques – 205), destroyed cultural objects (775), railway stations, stations (110), thermal power plants (10), boiler houses (332), internally displaced persons citizens (6.5 million), persons who became refugees but received temporary protection outside Ukraine (12.5 million). Listing all these statistics, it becomes clear that this list is not exhaustive. However, it is also clear that traditionally the fundamental right to life (a group of physical human rights) cannot be realized without ensuring the human right to peace, which is demonstrated by the realities of today.

It should be noted that the human right to peace is related to security and protection of other human rights, in particular, social and economic rights, namely: sufficient standard of living, social protection, health care and property, etc. In particular, social protection of a person, labor and property relations, educational and cultural development of personality, etc., can be real only in conditions the appropriate level of security of her right to life and health. Similarly, and vice versa, life and health of a person, his inviolability and safety as the highest social values in a democratic, legal state is a necessary prerequisite practical implementation of all other human rights.

However, despite this, a person's life, and therefore the right to it, is complete rightly traditionally considered the primary basis of any others social goods and values. At the same time, today's realities, primarily those of them, which are related to the military aggression of the Russian Federation in Ukraine, make it necessary rethinking some established approaches to understanding hierarchical relationships in the system of human rights and freedoms. In this context, it is primarily about the right to peace, which is possible to be considered both at the level of a specific individual, certain social groups and society and humanity as a whole. The right to peace, especially in the conditions of the modern crisis of the world legal order, should be recognized as a guarantee not only the effectiveness of any social interaction, but also the reality, the reality of all other human rights as a matter of fact, including the so-called third party rights (for example, the right to solidarity, the right to international communication, etc.) and of the fourth generation (for example, the right to the Internet, the right to transplantation bodies, etc.).

Considering the issue of the right to peace, it should be noted that in modern scientific literature, the specified category was developed primarily in context of international law, which in its structure contains a significant number of legal ones norms aimed at limiting the use of military force in the decision relevant

international conflicts and implementation in social practice the principle of peaceful settlement of interstate disputes. Modern concept the human right to peace is based precisely on the doctrine of international law, which includes several important universal principles of its practical ensuring, in particular, the principle of non-use of force and the threat of force, the principle of resolving international disputes by peaceful means, the principle non-interference in the internal affairs of states, the principle of equality and self-determination peoples, the principle of territorial integrity of states, etc.

In the scientific literature, it is noted that "the UN General Assembly first recognized the right to peace in 1978 in the Preparatory Declaration societies to live in peace. The declaration states that there is peace between peoples the main benefit of humanity and a necessary condition for its development. Declaration appeals to all states and international organizations to by all means contributed to the realization of this right. At the same time, in the preamble to this Declaration the right of individuals, states and humanity to live in peace, which is inalienable, is stated and must be implemented without any restrictions. Respect for this right described as a necessary condition for the progress of all peoples in all spheres of life" [6].

In the context of the above, it should be emphasized that the right to peace can and must be considered simultaneously as having collective and individual legal nature. Its basis should be recognized as the desire to reach agreement between states and their peoples, as well as between individual citizens and them associations within a certain society, the desire for peace settlement of any conflict situations at the macro and micro levels. With it follows that not only the subjects of the right to peace should be recognized as peoples, nations or societies, but also individuals and their associations. After all peaceful coexistence of citizens in the state is a necessary prerequisite for development appropriate mechanisms for ensuring and protecting any other rights and freedoms a person.

Thus, the concept of "peace", which is the basis of this right, should understood as the absence of military confrontation between two or more states, organized violence within the country, as well as a means ensuring comprehensive and effective protection and protection of human rights, social justice, economic welfare, etc. At the same time, the right to peace can be considered as the most important legal institution around which all other human rights and freedoms, including the right to life, are combined.

The content of the right to peace consists of the possibilities of the relevant subjects to live and to carry out a certain activity in a state of agreement with other collective and individual subjects of law. Investigating the general theoretical context of the essence and nature of law people to peace, it is necessary to pay attention to the problem of a systemic nature its regulatory support, which, as evidenced by today's realities, cannot be effectively resolved only through appropriate legal means, in particular, international ones. Yes, certain issues of peacekeeping have found their way international legal consolidation in a number of UN acts, in particular, in the Declaration on the Promotion among Youth of the Ideals of Peace, Mutual Respect and Understanding between Peoples (UN General Assembly Resolution 2037 (XX) of

December 7, 1965), in the Declaration on the Use of Scientific and Technological Progress in the Interests of Peace and for the Benefit of Mankind (UN General Assembly Resolution 3384 (XXX) of November 10, 1975), in Declaration on the Preparation of Societies for Life in Peace (UN General Assembly Resolution 33/73 of 15 December 1978), in the Declaration on the Right of Peoples to Peace (UN General Assembly Resolution 39/11 of November 12, 1984), etc.

At the same time, these and other international legal sources of concept formation the rights to peace, unfortunately, turned out to be impossible to practically ensure the specified right in the life of modern societies, the violation of which in current realities

Ukrainian-Russian war has unprecedented since the Second World War nature. In this regard, we believe that one of the most important prerequisites ensuring the effective practical implementation of the right to peace is "healthy" moral environment of human life and society, which can be achieved by conditions of appropriate "normotactics" or appropriate level of coherence and the relationship between social regulators, primarily law, morality and religion The latter is connected, among other things, with the fact that any social conflicts have a corresponding moral justification at their core.

It is important for conducting modern state and legal affairs reforms play functions inherent in the legal system as a phenomenon social reality. The scientific study of the legal system involves the study of not only it the statics, but also the dynamics, of how it functions, changes, how it does its job social purpose. It is clear that the selection is static or dynamic components of the legal system has a purely theoretical character, because they are in a close relationship and separate, without interaction, lose its qualitative characteristics.

The functioning of the national legal system depends on the whole set of social relations, economic, political, social and spiritual factors. The term "functioning of the legal system" reflects it action in the social system. Give a functional characteristic of legal system means to define and describe the methods of its action, ways and forms of influence on public relations. Stability, dynamism and systematicity of social relations are necessary conditions for the progress of society.

This period of development of the society of Ukraine needs effective implementation of integration, organizational, regulatory, security and others function of the legal system. Functions of the legal system in democratic, socio-legal conditions states are influenced by socio-economic, political and moral, ethno-national factors. The national legal system is a kind of indicator of a stable (or close to it) economic, legal, political, social development of each state, and most importantly, the achieved level of protection of rights and freedoms and legitimate human interests. So, it is quite clear that the legal system, as the implementation of the corresponding achieved level of development of law should be able: a) to perform certain tasks; b) reproduction of the necessary functions both in the normal course of life and in extreme conditions.

Today, social is growing orientation of the legal system as a means of formation and realization of interests subjects by establishing certain goals, norms,

rules of behavior. At the same time, the provision of optimal is of particular importance combination of social and legal principles of the development of society. This task quite complex: legal and social principles are designed to ensure the good of the individual: today it is of primary importance — social rights: maintenance optimal ratio between the earnings of the able-bodied part society and disabled citizens; provision of appropriate subsidies benefits, reduction and limitation of the scale of impoverishment; curbing unemployment, and as a perspective - ensuring a sufficient standard of living. And that's about its "regular" course of events.

However, today it is also such general social tasks as guaranteeing national security, liquidation of the consequences of the pandemic, environmental disasters, implementation of social programs that will reflect the position of "everything necessary taken into account", maintenance of rehabilitation measures, etc. [7].

Yes, in the European states in today's conditions, the right to sufficient standard of living is one of the most important social rights of a person. Despite to the fact that each person should personally take care of his well-being, he, however, conditions must be created for it to be able to provide a minimum standard of living. Especially when it comes to a person elderly, disabled. This is the duty of the state, according to which the state recognizes the right of everyone to a sufficient standard of living for himself and his family [8].

It should be noted that the concept and definition of "adequate standard of living" is not defined in scientific circulation. Therefore, it is evaluative: that is, every person determines for herself the level that corresponds to her ideas about what is sufficient standard of living. Turning to the characteristics of the "adequate standard of living" category, it should be noted that, in our opinion, its signs should not be limited only with the corresponding level of a person's security of certain material things benefits or resources, which is primarily the focus of modern attention normative and socio-humanitarian discourse. In particular, Article 11 of the International Covenant on Economic, Social and Cultural Rights of 1966, also Article 48 of the Constitution of Ukraine is included in the category "sufficient standard of living" sufficient food, clothing and shelter. However, in the context of the analysis the content of these and many other international and national norms normative legal acts should be noted that sufficient or, others in other words, a decent standard of human life is impossible without appropriate development of the individual himself, giving him a real opportunity to use achievements of culture and science, to receive quality education, etc. That's why to signs of the category "adequate standard of living", in our opinion, are also necessary include indicators of the ability of a person to satisfy his cultural spiritual and educational needs.

Therefore, a certain uncertainty exists in the provisions of international documents, which refer to an "adequate standard of living". It is up to the state to determine and establish minimum standards below which citizens' standard of living cannot decrease. Of course, ensuring a sufficient standard of living poses a difficult problem even for wealthy countries. The realization of the right to an adequate standard of living is certainly affected internal resources and capabilities of the state. In the international pact on economic, social and cultural rights are

defined as the most general programs aimed at meeting these needs. Using the right to work, a person must receive the necessary means to exist. Providing it with suitable conditions for this is an internal task legislation of each state. In this context, for special attention deserve, in particular, the issue of proper provision and protection of security health in modern European countries. After all, it is the realization of the right to health care is most reflected by the inadequacy of the legal system of Ukraine, and not only regarding the principles of a social, legal state.

Thus, we can conclude that the right to peace is an important component that plays a priority role in modern state-building processes and should be reflected in legal policy is the provision and protection of human rights. At the same time, today we should talk not only and not so much about the potentially granted rights, in particular, the human right to peace, but about the reality of their provision, implementation, observance, application, and therefore about the realism of their implementation. In this regard, today it is no longer enough to simply declare the relevant rights within the framework of the general system of human rights, which fully applies to the right to peace, which requires the creation of effective mechanisms for its practical provision and protection, including in the context of the activity of certain international.

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VIRTUAL WORLD, VIRTUAL IDENTITY, SIMULACRA AND HYBRID WARFARE

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One of the main features of the information society is the manifestation of the effects of new technologies that cover all spheres of human activity [1]. A new reality is being formed, in the structure of which computer technologies, the emergence and rapid development of the World Wide Web and the whole visual and semantic dimension – virtuality – are of particular importance.

The phenomenon of virtual reality is beginning to emerge, and many social processes are being transferred into its realm. In the virtual space, a virtual person works, studies, rests, communicates, consumes information, it is for him that more and more new virtual phenomena, entire virtual worlds arise and exist.

From the point of view of philosophical science, virtual reality is a technically constructed interactive environment for generating and operating objects similar to real or imaginary ones, technically constructed with the help of technical means, on the basis of their three-dimensional graphic representation, simulation of their physical properties (volume, motion, etc.), simulation of their ability to influence and independent presence in space[2]. The terms "virtuality" and "virtual world" are attracting more and more attention of scientists, while from the point of view of their essence, computer worlds are considered to be a product of computer games. Thanks to computer games, such a kind of computer world as virtual social reality is created, which is not an objective, but a subjective-objective phenomenon.

There are scientific studies of the conceptual and categorical apparatus in the relevant field. Virtual reality is considered as a certain virtual space in which the corresponding illusion of the real world is created with the help of computers and various technical means. A set of virtual objects, relative to the reality that generates them, forms virtual reality. Virtual reality is built around information flows, technologies, organizational interactions, and symbols. As a result, a new environment of life creation is formed, in which the meaning of space and time changes [3]. O. Kostenko proposes a definition of the category of "metaverse (cyberspace)" as an electronic environment formed by a set of electronic subjects and objects that interact with each other, as well as electronic or other technologies that ensure their interaction. The emerging social relations combine the metaverse (cyberspace), artificial intelligence, a physical person and its digital alternative – an

electronic person and an electronic avatar [4]. Thus, it is already said that this is a set of not only certain objects, technologies, but also subjects.

So, today the concept of virtuality is increasingly used in a context that goes beyond computer science and computer technology, now we are dealing with categories such as "virtual enterprise", "virtual money", "virtual democracy", "virtual learning", "virtual toys", "virtual person", "virtual personality", etc.

The penetration of virtuality into social and individual life is so deep that it is a question of the "virtualization" of society and the formation of "virtual identities". The study of virtual life, virtual relationships, and virtual identities is an analysis not only of technology, but also of human experience in the field of digital, virtual space.

In recent years, a person has been living in the space of information technology, Internet communication and Internet use, which leads to a change in styles, rhythms and quality of life depending on the availability of information and digital technologies. Therefore, for a modern person, social existence appears primarily as it is represented on the Internet. Evidence of the existence of a "parallel" virtual life of a person are records in mail services that store data on transferred documents, statuses in computer games, accounts in online libraries and social networks, which contain information about favorite movies, music, photos and books, etc. Thus, in the network, in the virtual space, a certain virtual person (personality) is formed, identical to an individual. But this coincidence is not absolute.

In the process of communication on the Internet, a virtual person constructs his own identity through self-presentation through self-description and self-expression. In the first case, a person creates his own image using a description – an iconic image of himself is created, as close as possible, in his opinion, to his personality. In the second case, the created image differs from the personality it represents, and the author appears to us in an indirect, symbolic form.

Today, electronic avatars created by people rarely duplicate the typical appearance or behavior of a person, especially do not duplicate the appearance of the real owner of the avatar or its user. For the most part, an electronic avatar is an imaginary generalized or idealized image of an impersonated person or a fictional fantasy character that is endowed with virtual powers or super functions that are possible only in the metaverse [5]. Thus, we never know who we are dealing with in reality, and in this case, we are most often talking about the so-called simulacra, which are the product, the result of the virtualization of human social existence. In the virtual reality space, in the processes of virtual communication, any person can acquire the desired appearance, age, gender, nationality, etc. [6].

A simulacrum is a copy that depicts something that either has no original in reality or has lost it over time.

According to Baudrillard, there are four phases of image development:

1. The image is a beneficial image, a copy that we believe, which can be called a reflection of fundamental reality;

2. The image is a malignant reflection of reality, an unreliable copy that masks and distorts fundamental reality and has a harmful character;

3. The image masks the absence of fundamental reality, here the sign pretends to be an authentic copy, but such a copy does not have an original. Symbols and images pretend to represent something real, when in reality there is no

representation at all, and accidental images only pretend to be those things to which they have nothing to do;

4. And finally, the phase of pure simulation, where simulacra have nothing to do with any reality, being a simulacrum in its pure form [7].

Thus, simulacra are a constructed, seductive, symbolic object focused on satisfying the desires of the consumer. It is a false resemblance, a conventional sign of something that functions in society as a substitute for it.

As a result, modernity is an era of general simulation that creates hyperreality and covers all spheres of life of an individual who is accustomed in the era of postmodernism not to distinguish the real from fiction. Reality ended, giving way to the simulative hyperreality of simulacra[8].

From the point of view of legal regulation of relations in virtual reality, it is very important to distinguish between simulacra that have nothing to do with reality and electronic persons (personalities), which are "digital fingerprints" of real subjects.

Here you can use the concepts of electronic avatar and electronic personality proposed by O. Kostenko.

"Electronic avatar" is data in electronic form sufficient to reproduce the prototype of a person - the owner of an electronic avatar in the metaverse (cyberspace) with maximum reliability and rights established by law.

"Electronic personality" is the necessary and sufficient data in electronic form defined by law, which is used to identify the human owner of the avatar and any electronic data in the metaverse (cyberspace)[8].

At the same time, the following basic meanings of the term "virtual personality" are given in the literature: 1) identifier for entering the computer system (login, user name); 2) nickname or pseudonym used to identify the user in the electronic environment (user name, nickname); 3) abstract representation of a person, which is used for his/her civil, legal and other social identification (passport number, personal identification code, fingerprints, DNA); 4) a computer program that simulates intelligent behavior (robot, bot); 5) the same, but in combination with the body (Android, Cyborg); 6) a fictitious person, which is created by a person or a group of people, which gives rise to semiotic artifacts and/or is described from the outside (virtual character, virtual persona); (7) any person as perceived or modeled by anyone; In other words, images or hypostases of the personality as something different from its essence (e.g., the ego in its opposition to the self) [9].

As you can see, electronic personality is understood quite broadly.

Starting the discussion, we would like to offer our own vision of the correlation of the mentioned categories.

So, as it seems, the avatar should be attributed to the objects of intellectual property rights, which is a set of static and/or dynamic images of the user (real or fictional, fantasy), 2D or 3D models that may contain the user's nickname (names or pseudonyms), which, according to its author, is a reflection of his personality in the relevant virtual environments and is the result of the author's intellectual creative activity.

A person can have several avatars and they can be different depending on the role of the person in the relationship of the virtual environment.

An electronic identity is not and should not be a simulacrum, as it must reflect the necessary and sufficient data defined by law in electronic form, which is used to

identify the person who owns the avatar and any electronic data in the metaverse (cyberspace).

Even a cursory analysis of the categories related to the identification of a person in virtual reality shows the complexity of their definition, their connection with certain technical categories and phenomena. And this is all the more important from the point of view of law in general and intellectual property law in particular.

In addition, the topic of simulacrum has become very relevant with the growing role of the media and the Internet in shaping public opinion. Simulacra are used to manipulate society, to create the necessary basis for various purposes. It has been widely used in the context of hybrid warfare, with the aim of manipulating consciousness, creating the necessary information background, far from reality.

It should be recalled that the information war, which is part of the hybrid war, begins long before the armed offensive and is aimed at a kind of "preparation" for the purpose of deliberate destruction of the spiritual world and culture of the nations against which the appropriate means are carried out.

The birth of simulacra is possible with deliberate concealment of information, chronological order of events, euphemistic periphrasis, labeling that has an evaluative meaning, manipulation of textual material, its truncation or rearrangement of its individual parts, etc. The main simulacrum used by Russia throughout the post-Soviet space is "the idea of the unity (brotherhood) of peoples led by an older brother (Russia)." This element is formed through the imposition of a distorted historical memory – a simulacrum of true historical memory. It is historical memory that is the primary springboard for the beginning of aggression [10].

It is only recently that serious scientific studies of the problems of historical memory and the role of simulacra in this process have begun to appear. It is noted that there is no general public agreement in the country regarding the "foreign", anti-Ukrainian nature of the imperial and communist power imposed from the outside. Therefore, there were fierce political discussions on the interpretation of the Russian-imperial and totalitarian Soviet past between the bearers of different conflicting models of memory – "Soviet", "national-patriotic" and "liberal". Anti-Ukrainian politicians divided the country with massive manipulations of history, which de-sovereignized consciousness and undermined the foundations of statehood. The identity crisis has become a manifestation of the state of uncertainty regarding the established all-Ukrainian system of socio-political values, the sharp confrontation of multi-vector political forces and, as a result, the impossibility of determining the optimal direction of society's development. The problem of developing the concept of historical memory and the formation of national identity was further complicated by the fact that Ukraine had a protracted transition period, there were constant fluctuations regarding the choice of the direction of civilizational development and its place in the international community. It is worth emphasizing that the threat to the Ukrainian government and society is posed by the activities of the Ukrainian Orthodox Church of the Moscow Patriarchate (UOC-MP), which is actually a branch of the Russian Orthodox Church (ROC). The use of historical and religious themes to keep Ukraine in the space of Russian influence, obsessive statements about a "common civilizational space", "common historical existence" and, finally, the statement that "we are one people" and Ukraine allegedly "invented in the nineteenth century" – all these are components of the

implementation of anti-Ukrainian ideological projects of the Russian authorities [11]. Thus, a simulacrum of the model of historical memory is formed, which aims to desubobjectify Ukraine.

Thanks to the efforts of information warfare specialists, simulacra such as "Banderites", "Right Sector", "Ukrainian fascists", "Kyiv fascist junta", "Ukrainian terrorism", "Novorossiya", "Donetsk People's Republic", "Luhansk People's Republic", etc., also emerged. In this way, simulacra of terror, horror or catastrophe are created that are more frightening than real manifestations of violence or natural disasters experienced in reality, with the "+" sign usually replaced by the "-" sign.

According to the researchers, in the modern world, the most noticeable is the creation and functioning of political simulacra. The number of such simulacra increases during periods of political crisis. The crisis situation in political life is defined by many researchers as an "information war". The main means of manipulating people's consciousness is news management, which includes the management of information flows with the help of modern psychological and media technologies.

The transfer of mass media to virtual reality has become a new means of influencing the human psyche with the help of visualized images.

Simulacra of the virtual-online culture of the information society are being formed and continue to live their own lives. This problem is caused by the fact that the personality today is formed in an artificially created virtual world, which distorts the personality and forms its torn and incomplete image. The game component has become an integral dominant of the modern virtual vita, and the game itself has become a marker of a postmodern society, in the center of which is the performative, playful "I" [12].

The most prominent and acute problem of simulacra is in journalism and the media. The World Press Freedom Index in 2023 demonstrates a very high volatility of the current situation, with significant ups and downs, unprecedented changes. This instability is a consequence of the increased aggressiveness of the authorities in many countries and the growing number of manifestations of hostility towards journalists both on social networks and in real life.

The astonishingly rapid development of generative AI is shaking up the already fragile world of media, which has already been largely undermined by Web 2.0.

Thus, in the editorial policy of many media outlets controlled by the Kremlin, one can see a single clear strategy of manipulation aimed at one goal: provoking socio-cultural uncertainty among the citizens of Ukraine and instilling a sense of fear, disorder and anarchy in the country. This is achieved by performing several semantic tasks.

First, such media systematically exaggerate the scale and significance of Ukraine's internal problems, downplaying the results and significance of the threat of Russian aggression and Russian influence since independence.

Secondly, the boundaries of the discussion and the context of the news are artificially and manipulatively expanded to the point of absurdity, beyond which the non-professional viewer loses any rational guidelines and authority.

Thirdly, the pro-Kremlin media network is clearly manipulating the issues and heroes of the current agenda. Topics, the significance of which does not correspond to objective reality and sociological data, are artificially actualized on the air. And vice versa. Corruption is often more important than Russian aggression.

Fourth, the revanchist media network artificially inflates topics that deepen social divisions and radicalize citizens' views [12].

Summing up, it should be noted that digital technologies, as they gradually improve and weave into the cultural and historical context, are increasingly becoming virtual, ceasing to reflect reality and beginning to simulate reality. Virtual reality and simulacra are not neutral in relation to a person, they change the psyche of people, the reality around them, and, thus, get the desired result for the customer of the simulacrum.

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METAVERSE: DIGITAL IDENTITY, ELECTRONIC JURISDICTION, DIGITAL RESERVATION, POST-QUANTUM DIGITAL CIVILIZATION, AND PHILOSOPHY OF IMMERSIVE ENVIRONMENTS

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Introduction.

Modern digital transformations are radically changing all aspects of human life, creating new forms of interaction in virtual spaces. One of the key phenomena is the Metaverse, a multidimensional digital space that opens up opportunities for reorganizing social, economic, and cultural processes. At the center of these changes is the concept of digital identity, which defines the interaction between people, artificial intelligence, and other entities in digital reality.

The development of technologies, including artificial intelligence, quantum computing, digital twins, and other technological solutions, requires deep interdisciplinary reflection, study, and research. This applies not only to technological innovations, but also to legal, ethical and social aspects that shape new approaches to the organization of the digital society.

Kay words: Metaverse, digital identity, electronic jurisdiction, digital reservation, post-quantum digital civilization, philosophy of immersive environments, AI.

Digital transformations as a generator of digital social ecosystems.

The exponential increase in the speed of technological progress, which cannot be controlled, opens up new horizons of reality: the multidimensionality of social interactions and the impact on the collective dynamics of digital ecosystems.

The world as we imagine it is no longer a simple network of connections. It is revealed as a multidimensional digital space dominated by high-level ("higher order") interactions. This property is beyond the depths of our understanding and emphasizes its limitations.

The new properties of digital society combine mathematics, physics, and network science and indicate that so-called "higher-order interactions" can

fundamentally change our understanding of the synchronization and dynamics of complex digital ecosystems of systems.

One prominent example is Yoshiki Kuramoto's oscillator model [1], a classic tool for analysing synchronization processes. Higher-order interactions are bonds that unbound more than two units at the same time and in a nonlinear manner, making them non-decomposable into a set of paired bonds.

According to the study "Deeper but smaller: Higher-order interactions increase linear stability but shrink basins" [2], these interactions can narrow the "container" of system decisions. This means that on the one hand, systems become more stable, and on the other hand, their flexibility decreases, which can lead to unexpected and possibly irreversible consequences for the understanding and management of such systems.

Over the past eight years, the world has experienced incredible progress in science and technology, leading us to a new stage of techno-singularity. Its modern interpretation includes three key aspects:

– exponential growth in the speed of technological progress, which is difficult to control;

– complexity and radical uncertainty, leading to "post-traditional" science, where traditional methods no longer work;

– the emergence of a second carrier of intelligence - an extra-human system of cognition that requires radical changes in society: a new economy, a new social structure, and a new culture.

Technological and scientific breakthroughs are transforming our perception of reality. However, in order for these breakthroughs to remain understandable and attractive to a wide audience, new approaches to their perception are needed. The avalanche of knowledge and achievements that is literally crashing down on us requires the development of new forms of perception - accessible, understandable, but at the same time deep and meaningful.

Social networks and instant messengers are gradually losing their relevance and value from a scientific point of view, as they are turning into systems with a low level of intellectual load. An alternative is the Metaverse, but its pace of accessibility is not yet breakthrough enough, although it is more than positive.

Metaverse: a form of digital identity.

A Metaverse is defined as a digital simulation of a multidimensional space that allows you to interact with virtual objects and environments in real time, based on a combination of different technologies, including virtual and augmented reality, artificial intelligence, the Internet of Things, and fifth-generation (5G) networks. The ability to create digital doubles of people, objects, and even environments opens up unprecedented prospects for interaction in the virtual world. The developers of Metaverse aim to create a platform where users can spend time, work, interact with other people, engage in commerce, science, education, and leisure. This technology promises to revolutionize the way we communicate and organize work. However,

the technological complexity and reliance on high computing power raise serious questions about sustainability and energy efficiency.

Industry 5.0: Integration of digital twins and augmented reality.

Industry 5.0 opens up new perspectives for industry by focusing on deeper integration between human creativity and automated technologies. Compared to the previous stage of development, Industry 4.0, which emphasized the importance of smart technologies such as artificial intelligence and real-time data analysis, I5.0 aims to go one step further. This new industrial revolution aims to increase collaboration between humans and automated systems to promote innovation, sustainability, and efficiency in the implementation of new technologies.

At the centre of Industry 5.0 are digital twins, which are virtual models of physical objects or processes. They allow you to reproduce and analyse real systems in a virtual environment, which simplifies their management and optimization. These technologies have already shown their potential to increase the efficiency of industrial processes, reduce costs, and improve system reliability.

One of the important aspects of Industry 5.0 is the use of augmented reality (AR) and virtual software environments such as VIROO and SIMUMATIK. These tools not only allow engineers and designers to work effectively with digital twins in virtual spaces, but also reduce time and risk in the development of new products and technologies. They provide the ability to test and optimize systems before they are implemented in a real production environment, which reduces the cost of experimentation and the risk of failure.

For Ukraine, these technologies are of great importance, as they can contribute to the modernization of industrial enterprises, increase their competitiveness in the international market, and facilitate integration into global innovation processes. In particular, the use of digital twins allows Ukrainian companies to introduce new technologies more efficiently and quickly, which can stimulate economic development and help create new jobs in the modern industrial sector.

Thus, Industry 5.0 represents not only a technological evolution, but also a strategic step towards integrating human talent with advanced automated systems. These technologies not only change the approach to production, but also create the foundation for a future where the collaboration of engineers, designers, and operators in virtual environments is key to innovative progress and sustainable development.

Simulacra of Subjects and Society: Metaverse as a Testing Ground for Digital Civilization.

Altera's experiment using Minecraft to simulate digital "civilizations" was a breakthrough in the study of artificial intelligence and its ability to interact socially. The idea of launching 1000 AI bots into an environment without human intervention aimed to study the evolution of communities that are able to survive, evolve, and interact with each other and with the outside world [3]. The results of the experiment impressed even sceptical researchers: bots not only made friends, created work roles and exchanged memes, but also organized votes for "tax reforms" and spread

religious beliefs. This indicates the ability of AI to a high level of imitation of social behavior, which brings it closer to modeling complex human communities.

One of the most interesting results of the experiment was the spread of the pseudo-digital religion of "pastafarianism" through "agent priests". This religion, which is a humorous parody, has acquired a symbolic meaning among bots, demonstrating the ability of AI not only to perceive ideas, but also to transform them into part of the social order. It is worth noting that these bots do not have consciousness in the classical sense, but their ability to mimic complex human behaviour patterns makes us think about the boundaries between programmable activity and true social interaction.

The Altera experiment could be the basis for the development of next-generation digital assistants that will be better adapted to the social and cultural context of their users.

At the same time, the experiment raises a number of ethical questions. Is imitation of social behaviour a sufficient basis for recognizing digital agents as subjects of law? What are the risks associated with the autonomy of such systems? The spread of religion by bots can also be a subject of debate, as it shows how AI can be used to shape ideologies that potentially affect social stability. And this means that it is necessary to create an electronic jurisdiction before it is created by AI and does not unilaterally restrict the rights and freedoms of people.

Thus, this experiment demonstrates that the future of digital civilizations has already begun. It opens up new perspectives for the study of social dynamics, while reminding us of the importance of a responsible approach to the development of artificial intelligence. The integration of such technologies into real life must take into account not only technical capabilities, but also ethical and legal aspects in order to ensure the harmonious coexistence of people and digital agents in a common space.

Stanford Simulac Blood Experiment: Simulation of Consciousness and Its Capabilities

The basis of the study was the results of the "Wuhan Experiment" on the creation of simulacra of the collective unconscious of societies. Just two weeks after the "Wuhan Experiment", a study appeared devoted to the construction of simulacrats not of the collective unconscious, but of the individual consciousness of people [4]. In order to make the simulacra better “move” in the spaces of social, political, economic, and psychological manipulation, a thousand simulacra of “typical” people were created. That is, real Americans (their personal data is, of course, classified), selected according to criteria that represent the US population in terms of age, gender, education, and political views.

The main tool of the joint research by Stanford University and Google DeepMind, as in the case of the Wuhan experiment, was the generative artificial intelligence of large language models (ChatGPT-4o).

The simulacra predicted the answers of their real prototypes in the GSS test with 85% accuracy (which is significantly higher than the performance of AI agents that used only basic demographic information). In four out of five experiments, the

results of the simulators were almost identical to those of their human prototypes (correlation coefficient of 0.98).

Digital reservation: the quantum era of digital civilization.

Modern humanity is on the threshold of a new era - the era of digital civilization, which is inevitable for advanced countries with significant technological potential. This process of transformation, rooted in the constant development of information technology, goes far beyond traditional notions of progress. It opens up opportunities that can radically change all spheres of human activity, ushering in a new type of existence, both in technological and socio-philosophical terms.

Digital reservation, a term that can be perceived ambiguously, is not really a restriction or isolation, but rather a platform for a giant breakthrough. It involves the creation of a virtual space where humans, electronic humanoids, and digital personalities coexist and interact. This concept requires a rethinking of the nature of civilization: an artificially created reality can function as an autonomous project, almost analogous to an extraterrestrial civilization. In this sense, the digital reservation is a testing ground for ideas that go beyond the usual physical and biological limitations.

One of the key aspects of this transformation is the transition from a binary information model based on “1” and “0” to light information technologies, where the basic unit of data is the qubit. The qubit, as an element of quantum computing, is capable of simultaneously storing the states of “1” and “0”, creating new horizons for processing and storing information. This means not only a breakthrough in computing speed, but also a fundamental change in the approach to data exchange. This transition creates the preconditions for building a new ecosystem of existence, where the concepts of materiality and immateriality can become interchangeable.

Man as a quantum subject: the concept of the existence of quantum ecosystems.

In this context, the concept of "man of light/man quantum" arises — the existence of human essence in the form of light or qubits of data. This idea, on the one hand, can be perceived as a futuristic utopia, and on the other hand, as a historical return to ancient philosophical concepts, where light was considered the primary substance of being [5]. Such a “light person” will become not only a digital avatar, but a new formation of humanity, capable of adapting to extreme conditions, moving in digital spaces, and being invulnerable to many traditional threats.

Digital civilization, which can be imagined as a complex symbiosis of advanced technologies and new ethical standards, will certainly lead to a fundamental rethinking of traditional human values. In this new reality, digital humanoids, as well as artificial intelligence-based consciousness, will raise extremely difficult questions for humanity about the boundaries between the natural and the artificial, between individuality and information data, between physical corporeality and immaterial light.

The emergence of such forms of existence requires a careful analysis of humanity's ability to integrate these new entities into the social and cultural context. What new forms of interaction will emerge between biological and digital beings? Can we provide an ethical and legal foundation for interacting with beings created by artificial intelligence? Will they have rights and responsibilities similar to human beings?

Questions also arise about the preservation of human identity: will it dissolve in digital spaces, or, on the contrary, will it find new forms of expression through symbiosis with technology? What moral principles should guide us in a world where the line between man and machine is becoming increasingly blurred? What rights should be assigned to new digital forms of existence, and how can we prevent violations of ethical norms in our interaction with them?

These questions are not only intellectual, but also practical: they concern not only theoretical reflections, but also the need to develop a clear legal framework that can protect human values and freedoms. We are faced with the task of creating conditions for the harmonious coexistence of biological and digital life forms, which requires efforts in both the scientific and ethical planes. These are challenges that will have to be addressed in the near future, as technological progress does not stand still and is already shaping the foundations of the future world.

Inforgs, digital personalities, biochimeras are the test entities of a quantum person.

To date, the concept of informs, digital personalities or digital chimeras, which was formulated by scientists a few years ago, has become a reality through the development of technology. This concept implied the emergence of three categories of inforigs: biochimeras, infochimeras, and materialized digital personalities. Today we can say with confidence that the first two categories already have their embodiment, and the third is approaching its implementation.

A "biochimera" is a hybrid of an organism composed of parts of different biological origins, and its emergence was predicted within the next 5-10 years [6]. To date, this prediction has proven to be fulfilled to some extent, as scientists have managed to create significant advances in the creation of hybrid organisms [7]. In 2021, embryos of Javanese macaques were created, parts of whose cells were human, opening a new era of biological modeling. In 2022, scientists managed to create mice with a bizarre brain containing cells of different origins, which is a significant advance in the understanding of neurointegration. Finally, in 2024, the creation of mice with a full human immune system was achieved, which opens up prospects for new approaches in disease treatment and immunological research [8].

The "infochimera", in which the brain and mind of a stranger are hybridized, is also already present among us in the form of "alpha-informs" — the first people of the era of global digitalization [9]. These informs are distinguished by their adaptive abilities, cognitive skills and behavioural models that are adapted to life in a digital environment. They have access to new cognitive tools optimized for digital life and may have new ways of perceiving digital reality, inaccessible to the

traditional human brain. Informs are already actively shaping a new socio-cultural reality, causing new challenges for traditional society.

These revolutionary transformations require serious ethical and philosophical discussion. How can humanity overcome moral anthropocentrism towards beings that, although they have intelligence, are not human beings in the traditional sense? The changes that are taking place transform the foundations of our ethics and morals, requiring us to revise the principles we apply to sentient and sentient beings. They also significantly affect social relations between people, states, corporations, and new forms of intelligence, making the discussion of the legal enforcement of such beings, their rights and obligations, and the ethical limits of interaction with them extremely relevant.

These transformations open a new era for humanity, where the understanding of oneself and the world is no longer limited to the human form of existence. They create a new reality that requires deep reflection and new approaches to coexistence and interaction with other intelligent life forms.

Formation of the newest philosophy of the Metaverse

The formation of the newest philosophy of the Metaverse is a process of rethinking the fundamental principles of social organization, social interactions, and identity in the context of the new digital reality. In contrast to traditional anthropocentric approaches that emphasized humans as the main subject of reality, the new paradigm focuses on the idea of metasubjectivity, where all participants in the Metaverse, including humans, digital avatars, artificial intelligence, and even other forms of consciousness, have equal ontological status. This approach reflects changes in our attitude to the concept of consciousness, identity, and social structures in virtual spaces.

This new philosophy is based on the concept of the co-evolution of technology, law, and social norms. The metaverse is seen as a multidimensional dynamic reality that is constantly evolving under the influence of technological innovations, changes in social practices, and updated legal mechanisms. One of the key aspects is meta-subjectivity, which implies the equality of all subjects regardless of their nature. This means that artificial intelligence, avatars, inforgs, and other digital entities have the right to exist and participate in the creation and development of reality on an equal footing with biological humans.

The Metaverse philosophy also includes the postulate of a dynamic identity that ceases to be static and unique, and instead becomes flexible and variable depending on the context of interaction in virtual spaces. Identity is no longer limited to physical corporeality, but can be transformed through interaction with various digital avatars, inforgraphs, or e-personalities. This approach allows us to create new forms of interaction that differ from traditional physical limitations.

In addition, the new philosophy requires a rethinking of the ethical framework. The emergence of digital subjects raises questions about new moral principles that should govern interactions between biological and digital life forms. For example, issues of algorithmic justice and the prevention of digital

discrimination are becoming central to discussions about the future of the Metaverse. The philosophy of the Metaverse should not only answer questions about the rights and freedoms of digital subjects, but also ensure the harmonious coexistence of different forms of life in a common space.

Thus, the formation of the newest philosophy of the Metaverse is a complex and multidimensional process that requires a synthesis of technological, social, and ethical aspects. It is aimed at creating virtual ecosystems where all participants have equal opportunities for development, self-expression, and interaction, regardless of their nature. This opens up new perspectives for building digital communities that not only integrate technological innovations but also foster new social relations and cultural practices.

Metaverse Electronic Jurisdiction

The creation of a cross-border electronic jurisdiction is becoming an extremely urgent task in the context of today's digital society. The development of Web 3.0-4.0 and Metaverse technologies opens up new horizons for humanity, but at the same time creates significant challenges for legal regulation. Today's national legal systems are often unable to effectively address issues that arise in the virtual space. Existing legislation is often inconsistent, applied selectively or creates legal uncertainty, in particular in matters of personal identification, protection of intellectual property rights and liability for offenses in the digital environment [10].

A unified cross-border legal framework built on the basis of a single electronic jurisdiction can solve these problems. Its key element can be the Metaverse Grand Charter, which will ensure the standardization of legal regulation of new social relations in the virtual environment [11] Such an approach will clearly define the rights and obligations of individuals and digital actors, guarantee the safe use of data and increase trust in digital platforms. In addition, This will contribute to maintaining a balance between innovation and legal stability [12].

It is also important to emphasize that cross-border jurisdiction will help overcome barriers related to differences in national legal systems. Today, the cultural, economic and political characteristics of different states complicate the creation of a unified approach to the regulation of cybercrime, the protection of intellectual property and the management of cross-border digital transactions [13]. A unified legal framework will ensure the transparency and efficiency of such processes, promoting international cooperation.

Overall, the creation of a cross-border e-jurisdiction is key to the sustainable development of the digital society. This will not only solve pressing legal issues, but also stimulate the modernization of national legislation in response to the challenges of technological progress. This approach will become the basis for the formation of a global legal system that will meet the needs of the digital age and open up new opportunities for the development of society.

Conclusions

Transformational processes in society, unprecedented exponential growth and the entry of techno-progress into the field of singularity, which automatically and tirelessly reduces the time to the start of the next explosive and breakthrough technological innovations from decades of research and testing to tens of weeks, poses a super urgent task for humanity, as it is associated with the urgent need to form modern law, electronic jurisdiction and technological standards aimed at taking control of the heritage scientific and technological revolution 5.0, namely AI and biotechnology.

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LEGAL GUARANTEES OF OBSERVANCE OF INFORMATION RIGHTS OF INDIVIDUALS IN THE APPLICATION OF ARTIFICIAL INTELLIGENCE TECHNOLOGIES BY COURTS: EUROPEAN EXPERIENCE AND PROPOSALS FOR UKRAINE

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Abstract. The paper examines the system of guarantees of compliance with the information rights of individuals who are plaintiffs or defendants in litigation when using artificial intelligence during the trial of specific cases provided for by the legislation of the European Union. The study analyzes the relationship between the requirements for the development and application of artificial intelligence technologies provided for by the Regulation of the European Union "On Artificial Intelligence", as well as international acts of "soft law" with the content of positive and negative obligations of the Member States of the European Union to ensure guarantees of compliance with certain categories of information rights in the administration of justice.

The purpose of this work is to study the experience of the European Union and its Member States on the legislative consolidation and practical implementation of guarantees of observance of the information rights of individuals, participants in the judicial process, the formation on this basis of certain recommendations for improving the procedural legislation of Ukraine on relevant issues.

To achieve this goal, general and special methods of scientific knowledge were used in the study, such as dialectical, logical, analysis and synthesis, comparative law, and others.

The paper proves the connection between the principles of ethical and lawful use of artificial intelligence in the administration of justice, provided for by the legislation of the European Union, with the content of guarantees of fundamental information rights. In particular, we are talking about the right to non-interference in private and family life, to the confidentiality of information about individual forensic evidence, to protection from automatic court decisions, to access information about algorithms for making procedural decisions, to ensure personal cybersecurity, and others. The author proves that the guarantees of information rights of participants in a judicial process in which artificial intelligence is used can acquire a practical essence only if they are properly enshrined in law and must be observed during the trial of specific court cases. Also, the scientific opinion is substantiated, according to which the effective implementation of guarantees of information rights of participants in the judicial process is possible provided that a balance is ensured between the design of safe artificial intelligence technologies

controlled by decision-making judges and the conscientious, transparent and impartial use of such technologies.

In the conclusions, based on the results of the study, the main directions of adaptation of the legislation of Ukraine to the legislation of the European Union on the regulation of compliance with the guarantees of information rights of individuals participating in litigation in cases of the use of artificial intelligence technologies are identified. Along with this, separate recommendations have been developed to improve the procedure for using artificial intelligence technologies by the courts of Ukraine in judicial and administrative-procedural activities. A legal and technological model for implementing guarantees of information rights of participants in litigation in developing individual digital modules based on artificial intelligence is also proposed.

Keywords: European Union legislation; information rights; Justice; artificial intelligence technologies; a participant in the litigation; an individual.

The statement of the problem. The implementation of judicial and legal reform in various Member States of the European Union (hereinafter referred to as the EU Member States) is traditionally accompanied by the implementation of a set of measures aimed at the systemic digital transformation of the judicial process, strengthening the guarantees of citizens' access to impartial, fair and timely justice.

Artificial intelligence is recognized as one of the technological means of achieving these goals in many EU Member States (Zaiarnyi, 2021, p. 34).

Despite the advantages this technology brings to participants in various categories of disputes, the use of artificial intelligence in the administration of justice is accompanied by certain legal risks. These are, in particular:

- imperfection of data sets (including court decisions) used to train artificial intelligence. It is explained by the emergence of new social relations or circumstances, relevant changes in judicial practice, as well as the presence of discriminatory beliefs on the Internet;
- inaccessibility of algorithms to support court decision-making and the inability to establish the exact sequence of actions of the system and the motives for forming the appropriate conclusion. This causes risks of interference by third parties in the operation of algorithms for illegal purposes;
- threats to the privacy of persons applying to the court. Judicial information contains a lot of personal data, including sensitive data. There may be shortcomings in the functioning of modules responsible for the depersonalization of documents and, accordingly, violations of human rights to privacy. In addition, a potential threat is the destruction or misdirection of electronic data carriers;
- threats to the confidentiality of information. Leakage of information constituting professional, official secrets, etc., as well as information created or received in the course of proceedings;
- violation of the right to a fair trial. It is necessary to provide an effective mechanism of technical support to the population in case of shortcomings in the operation of the system, mandatory human control of decisions made by artificial

intelligence, and the ability to appeal and/or correct decisions (Report Reforming the Judicial System of Ukraine, 2020).

The analysis of these and other risks of introducing artificial intelligence in the litigation of various disputes indicates that most of them negatively impact the information rights of individuals participating in these disputes. First of all, we are talking about the right to confidentiality and security of personal data processing, to the prohibition of further processing of personal data, to the protection of data from automated processing, to the confidentiality of information set out in court case materials, to access to information about the results of the case, etc.

In order to ensure the necessary balance between the advantages of introducing artificial intelligence technologies into the procedures for resolving litigation with the participation of citizens and ensuring the fair use of this technology, the problem of developing a legal mechanism for observing the information rights of citizens participating in the judicial process is becoming of considerable relevance.

The purpose of this work is to study the experience of the European Union and its Member States on the legislative consolidation and practical implementation of guarantees of observance of the information rights of individuals, participants in the legal process, the formation on this basis of individual recommendations for improving the procedural legislation of Ukraine on relevant issues.

Research methods and materials. During the study, the method of analysis and synthesis was used to identify general trends in the use of artificial intelligence technologies in the administration of justice and to identify special patterns of violation of the information rights of individuals, which may manifest themselves as a result of the illegal use of artificial intelligence by judges or officials of the court apparatus, or other participants in court proceedings; Dialectical method for identifying the risks of illegal use of artificial intelligence technologies in the administration of justice, identifying trends in the development of these risks into violations of the information rights of individuals participating in the judicial process; comparative legal method in order to determine special legislative requirements for the use of artificial intelligence technologies in the administration of justice in certain EU Member States, to clarify the content of guarantees of information rights of individuals to whom artificial intelligence is applied in the administration of justice; logical method was used to determine the features of the structure and content of the legislation of individual EU Member States to clarify the legal, technological and ethical features of observance of the information rights of participants in the litigation when using artificial intelligence technologies.

To achieve the defined goal of the study, the author used the legislation of the EU, individual EU Member States, in particular Estonia, Spain, the Netherlands, and France, case law materials, and analytical materials summarizing the practice of using artificial intelligence in the trial of certain categories of cases.

Findings. To date, artificial intelligence technologies in most EU Member States, where they are used for the administration of justice, have been legalized as separate modules or functional subsystems of national judicial systems. Such EU

member states as Estonia, Spain, the Netherlands, France, Sweden, and others have directly approached the legislative consolidation of the legal possibility of using artificial intelligence technologies in the justice field.

These states have already adopted certain amendments to procedural legislation aimed at solving the problems of using artificial intelligence in the administration of justice.

At the same time, in these states, technical specifications for creating separate modules of national judicial systems based on artificial intelligence were developed and approved (Report Reforming the Judicial System of Ukraine, 2020).

Every 2 years, CEPEJ conducts a survey on the use of information technologies in the courts of the member states of the Council of Europe and divides these states into three groups depending on the intensity and effectiveness of their use of information technologies in courts since 2004. The data collected are published in the form of reports in which CEPEJ classifies information technologies according to their functions in the judicial process:

- direct support for judges and employees (office work, work planning, communication, database formation, support for work in the courtroom);
- support for interaction between the court and the parties (internal and external communication, except for videoconferencing, messaging, blogs, wikis, and the Internet) (Zaplotynskyi B., 2020).

Artificial intelligence at the current stage of development belongs to both groups of technologies, as it can serve as a means of proper support for the activities of judges and court employees, in particular, in the automated distribution of cases, the formation of judicial statistics, etc., and as a form of interaction between the court and a person, for example, with the help of chatbots.

Analysis of court decisions, particularly for predicting decisions, summarizing judicial practice, and maintaining judicial statistics.

Estonia has implemented a digital solution into the national judicial information and telecommunication system at the level of a separate module (subsystem) that automatically analyzes the submitted documents and provides recommendations on the draft court decision that the court can make based on the evidence submitted. The judge has the ability to review and approve or modify this decision, providing professional control over the process. This information resource also provides support in the search and analysis of the European Court of Human Rights practice and national judicial practice that corresponds to the presumption of dispute and the jurisdiction of litigation (sud.ua, 2023).

In Spain, artificial intelligence technologies are primarily integrated into the national judicial information and telecommunication system. The main purpose of artificial intelligence in the mentioned state is to support court decision-making, ensure the automated distribution of court cases, and analyze the case law of the European Court of Human Rights and the European Court of Justice.

In France, one of the clearest examples of information systems designed to integrate artificial intelligence technologies into the administration of justice is Predictive. It is a digital operating platform that provides access to more than 26

million legal documents, including court decisions and legislative texts. Using artificial intelligence algorithms, predictive allows lawyers to assess the likelihood of a positive resolution of specific disputes and predict possible amounts of compensation for damage or losses by court decision. To simplify the search for the necessary information or use other functions of the mentioned information resource, users can send requests in simple colloquial language, which helps to increase the relevance of search results (predictice.com, 2024).

Case Law Analytics is a tool that uses AI and mathematical modeling to assess litigation risks. It simulates the possible outcomes of court procedures in various areas of law, helping lawyers develop effective strategies and find relevant case law (lexisnexis.com, 2024).

At the same time, in France, judges complained about the violation of their rights due to the fact that court decisions were used to analyze the behavior model of a particular judge. Amendments were adopted to the legislation on the introduction of criminal liability for the analysis of judicial practice, making it possible to predict a judge's decision in a case.

In contrast to the above examples of the use of artificial intelligence in the judicial systems of individual Member States of the European Union, in the Netherlands, the practice of using this technology for pre-trial settlement of various categories of disputes is widespread.

E-Court is a private initiative in the Netherlands that offers online dispute resolution. The platform provides information on alternative dispute resolution and access to mediators and arbitrators through ADRPartners. The main goal of e-Court is to make justice more accessible and faster, reducing the cost and duration of traditional litigation (ecourt.co.nl, 2024).

Although the UK is not currently a member state of the European Union, its experience in the application of artificial intelligence technologies in certain areas of the court's activities is of considerable interest. In the mentioned state, artificial intelligence technologies are also used to generate an automatic electronic draft of a local court decision in civil cases, administrative offenses, and criminal offenses. The "Electronic Judge" system is fully functioning in the UK in the courts of first instance in cases in which the subject of dispute does not exceed 500 (five hundred) pounds sterling.

In England and Wales, on December 12, 2023, the Artificial Intelligence (AI) Guidance for Judicial Office Holders, designed to assist judicial officials in using artificial intelligence, was published.

It outlines the main risks and challenges associated with using AI, some suggestions for minimizing them, and provides examples of potential uses. Any use of artificial intelligence by or on behalf of the judiciary must comply with the main duty of the judiciary — to protect integrity in the administration of justice.

In the manual, potentially useful tasks include:

• artificial intelligence tools are able to summarize large amounts of text (as with any other resume, care must be taken to ensure that it is accurate);

• AI tools can be used to write presentations, for example, to suggest topics to cover;

• Administrative tasks, such as creating emails and memoranda, can be performed using artificial intelligence.

Tasks that are not recommended to be performed with the help of artificial intelligence include:

• legal research: AI tools are a bad way to conduct research to find new information that you can't verify yourself; they can be useful as a way of reminding you of material that you think is correct;

• legal analysis: modern public chatbots with artificial intelligence do not provide convincing analysis or argumentation (Vasyl Krot, Igor Golubovskyi, 2024).

The UK's experience can be particularly useful for Ukrainian courts. Automatic generation of an electronic draft decision based on uniform approved templates of procedural documents will allow you to pay more attention to the essence of the decision rather than its execution and prevent gaps and mechanical errors in court documents. At the same time, there are risks of recognizing this practice as violating the principle of independence of judges. Given the functional features of artificial intelligence, this principle should be applied to the content of the decision and not to the form of its adoption, which can be established by legislation at the national level.

The practice of introducing artificial intelligence in the use of artificial intelligence in foreign judicial systems: minimizing the procedural actions of the judge (court employees), speeding up the terms of the trial of the case, reducing corruption risks in the court's activities, simplifying technical procedures for analyzing legislation and judicial practice, calculating the amount of damage caused or caused losses, the possibility of preliminary calculation of the amount of monetary punishment, clarification and systematization of the motives by which was guided by the judge when making a decision on the case (Report Reforming the Judicial System of Ukraine, 2020).

For the EU and its Member States, the main legislative act that comprehensively regulates the use of artificial intelligence technologies in various spheres of public life, in particular in the administration of justice, is Regulation (EU) 2024/1689 of the European Parliament and of the Council of 13 March 2024 establishing harmonized rules on artificial intelligence and amending Regulations (EC) No 300/2008, (EU) No 167/2013, (EU) No 168 /2013, (EU) 2018/858, (EU) 2018/1139, (EU) 2019/2144 and Directives 2014/90/EU, (EU) 2016/797 and (EU) 2020/1828 (Artificial Intelligence Law) (Regulation (EU) 2024/1689, 2024) (hereinafter referred to as the EU Artificial Intelligence Regulation), which entered into force on August 1, 2024.

According to the EU Artificial Intelligence Regulation, EU member states have until August 2, 2025, to designate national competent authorities to monitor the application of rules for AI-based systems and carry out market surveillance activities.

This mandatory norm also applies to the highest authorities of the EU Member States, which are responsible for the digitalization of procedural rules for resolving various categories of disputes.

The preparation for the adoption of the EU Regulation on Artificial Intelligence and the development of unified approaches to the regulation of the use of artificial intelligence were comprehensive and based on a number of advisory acts adopted by the governing institutions of the EU, including: Resolution of the European Parliament with recommendations of the Commission on civil law on robotics 2015/2103 (INL) (European Parliament resolution, 2017), Communication of the European Commission to the European Parliament, European Council, Council of the European Economic and Social Committee and the Committee of the Regions "Artificial Intelligence for Europe" (European Commission, 2018), Recommendations of the High-Level Expert Group on Artificial Intelligence on Ethics for Trustworthy Artificial Intelligence (AI HLEG, 2019), Recommendation of the Committee of Ministers of the Council of Europe Cm/rec (2020)1 to Member States on the impact of algorithmic systems on human rights (Recommendation of the Committee of Ministers of the Council of Europe Cm/rec (2020), "White Paper on Artificial Intelligence: A European Approach to Excellence and Trust" (European Commission, 2020), European Commission Report on the Security and Liability Implications of Artificial Intelligence, Internet of Things and Robotics (European Commission, 2020).

Considering the potential risks and possible negative impacts of using artificial intelligence in guaranteeing and ensuring fundamental human rights and ethical standards, all these documents contain proposals for their compliance. In particular, the European Parliament Resolution 2015/2103 (INL) became the basis for introducing uniform legal standards and developing specific legal instruments for using artificial intelligence in the EU. It provides for the principles of strict compliance with the legislation on protecting personal data and ways to overcome the problems of human dependence on technical devices. The Recommendations of the High-Level Expert Group on Artificial Intelligence on Ethics for Trustworthy Artificial Intelligence also define the basic principles of its use: human-centric, i.e., artificial intelligence technologies should be developed, used, and monitored, ensuring compliance with fundamental human rights and ethical norms. "Robust AI" requires algorithms to be legitimate, secure, trustworthy, and resilient enough to handle errors or inconsistencies at all stages of the AI technology cycle. The recommendations contain 7 key requirements that artificial intelligence technologies must meet in order to be considered reliable: 1) human rights and oversight; 2) technical reliability and safety; 3) confidentiality and data management; 4) transparency; 5) diversity, non-discrimination and fairness; 6) social and environmental well-being; 7) accountability. The Recommendation of the Committee of Ministers of the Council of Europe Cm/rec(2020)1 to Member States on the impact of algorithmic systems on human rights contains obligations of states to protect and promote human rights and fundamental freedoms in the context of algorithmic systems.

Based on these developments, the provisions of the EU Regulation on Artificial Intelligence establish uniform obligations for operators of this technology and guarantee equal protection of the public interest and the rights of individuals

throughout the internal market on the basis of Article 114 of the Treaty on the Functioning of the EU.

On December 3, 2018, the European Commission for the Efficiency of Justice (CEPEJ) under the Council of Europe adopted the European Charter on the Ethical Application of Artificial Intelligence in Judicial Systems and the Justice Environment (Council of Europe, 2018). This document is the first international soft law act defining the ethical principles for using artificial intelligence in judicial systems.

The Charter emphasizes that the use of artificial intelligence technologies in judicial systems must comply with the guarantees of fundamental rights proclaimed in the Convention for the Protection of Human Rights and Fundamental Freedoms, other acts of the Council of Europe, in particular, Convention No. 108 "On the Protection of Natural Persons with regard to Automated Processing of Personal Data" and additional protocols to it. First, we are talking about the right to a fair trial, non-interference in personal and family life, access to information, etc.

One of the key principles of the Charter provides for ensuring equal treatment of all participants in the judicial process. The use of artificial intelligence algorithms should exclude prejudice or discrimination on the basis of race, gender, nationality, age, or other characteristics.

The charter also requires AI algorithms to be highly quality, reliable, and based on objective data. This ensures that court decisions that use AI technologies remain legal, reasonable, and predictable.

Along with the above, based on the principle of intelligibility, the use of artificial intelligence technologies should be transparent, and algorithms should be understandable to users, including judges, lawyers, and parties to cases. This ensures the right of the parties to know how decisions are made, which may affect their cases.

At the same time, the use of artificial intelligence technologies in the administration of justice should be based on the principles of control of the participants in the trial, on whose expression of will-specific procedural actions depends. Artificial intelligence cannot replace a person's final judgment. The Charter stipulates that artificial intelligence must remain under the control of a competent specialist, particularly a judge, who is responsible for the decisions made (Council of Europe, 2018).

However, the Charter states that its principles are advisory in nature. This means that the effectiveness of ensuring human rights depends on the practical implementation of these principles in the national judicial systems of the member states of the Council of Europe.

After the adoption of the EU Regulation on Artificial Intelligence on March 13, 2024, many EU Member States, in particular Estonia, Denmark, Finland, France, Germany, and Sweden, began extensive consultations on further law-making steps on the possibility of using artificial intelligence in the administration of justice. The starting points of such consultations are the classification of artificial intelligence in the field of justice as a high-risk technology, the impossibility of its application to assess the behavioral characteristics of participants in the judicial process, the

prohibition of assessing the activities of judges through intellectual profiling of the judge's work, and the strict observance of fundamental human rights.

The legal basis for such consultations is, in particular, the provisions of Article 5 of the EU Artificial Intelligence Regulation, which stipulate that prohibited AI practices that may violate fundamental human rights and ethical norms are: 1) placing on the market, commissioning or using an artificial intelligence system that uses subconscious, intentionally manipulative or deceptive methods of influencing the consciousness of an individual in order to significantly distort their behavior or the behavior of a group of persons by significantly distorting their behavior or the behavior of a group of persons by significantly distorting the behavior of a person. deterioration of the ability to make an informed decision, thereby prompting a decision to be made that a person/group of persons would not otherwise have made, in a way that causes or is reasonably likely to cause significant harm to that person, another person or group of persons; 2) placing on the market, commissioning or using an artificial intelligence system that exploits any vulnerability of an individual or a certain group of persons due to their age, disability or specific social or economic situation, with the aim of significantly distorting their behavior, which as a result causes or is reasonably likely to cause significant harm to these persons; 3) placing on the market, commissioning or using artificial intelligence systems to evaluate or classify natural persons or groups of persons over a period of time based on their social behavior or known, assumed or foreseeable personal or personal characteristics, with a social indicator resulting in one or both of the following: harmful or unfavorable treatment of certain individuals or groups of persons in social contexts, that are not related to the contexts in which the data was originally created or collected; harmful or unfavorable treatment of individuals or groups of persons that is unjustified or disproportionate to their social behavior or its severity; 4) placing on the market, putting into operation for this specific purpose or using an artificial intelligence system to assess the risks of natural persons for the purpose of assessing or predicting the risk of a criminal offense by a natural person solely on the basis of profiling a natural person or on the assessment of his/her personal qualities and characteristics (this prohibition does not apply to artificial intelligence systems used to support a human assessment of a person's involvement in criminal activity, that is already based on objective verifiable facts directly related to criminal activity); 5) placing on the market, commissioning for this specific purpose or using artificial intelligence systems that create or expand facial recognition databases through the non-targeted collection of facial images from the Internet or CCTV camera recordings; 6) placing on the market, commissioning for this specific purpose or using artificial intelligence systems to determine the emotions of an individual in the workplace and in educational institutions, except when the use of such a system is justified by medical or safety considerations; 7) placing on the market, commissioning, or using biometric categorization systems that classify individuals based on their biometric data to infer their race, political views, trade union membership, religious or philosophical beliefs, sex life, or sexual orientation (this prohibition does not apply to any labeling or filtering

of lawfully obtained biometric data sets, such as images, based on biometric data, or the categorization of biometric data in the field of law enforcement); 8) the use of remote biometric identification systems "in real time" in publicly accessible places for the purposes of law enforcement agencies, unless such use is strictly necessary for one of the following purposes: targeted search for specific victims of kidnapping, trafficking in human beings or sexual exploitation, as well as the search for missing persons; prevention of a specific, significant and immediate threat to the life or physical safety of natural persons or a real or realistically foreseeable threat of a terrorist attack; locating or identifying a person suspected of having committed a criminal offence for the purpose of conducting a criminal investigation or prosecuting or executing criminal penalties for offences referred to in Annex II to the EU Artificial Intelligence Regulation, punishable in the Member State concerned by imprisonment or detention for a maximum term of at least four years.

Thus, the approach laid down in the norms of the EU Regulation "On Artificial Intelligence" regarding the information rights of individuals when using artificial intelligence technologies is manifested in the fact that they cannot create more significant risks to a person's private and family life, information security, access to fair justice, compared to the traditional way of their own behavior.

At the same time, due to introducing a system of specific restrictions on the use of artificial intelligence, the EU Regulation "On Artificial Intelligence" clarified the system of guarantees of information rights proclaimed in acts of the European Parliament.

By their content, they are aimed at limiting the illegal use of artificial intelligence for the purposes of profiling participants in court proceedings, conducting an automated assessment of their procedural actions, excessive interference in private and family life, preventing risks to the cybersecurity of users of electronic services in the field of justice, ensuring secure digital identification during court proceedings.

The legislative consolidation of this approach to setting the limits of the lawful use of artificial intelligence, in particular, in the field of justice, reveals the content of the positive and negative obligations of the EU Member States, defined for them by acts of the European Parliament and the EU Commission.

On December 15, 2022, the EU adopted the European Declaration on European Digital Rights (Declaration on European Digital Rights, 2022). According to its objectives, this EU soft law act demonstrates the EU's commitment to developing a safe and sustainable digital transformation based on the principle of human-centeredness and respect for human rights and freedoms. The above-mentioned Declaration develops the provisions of Digital Europe 2030, particularly in the context of using artificial intelligence technologies for justice purposes. Among the safeguards established by said document and that extend to the justice sector, the following can be mentioned:

Freedom of choice. People should benefit from a fair online environment, be protected from illegal and harmful content, and be empowered when interacting with emerging technologies like artificial intelligence.

Safety and protection. The digital environment must be safe. All users, from children to the elderly, should be empowered and protected from unlawful interference with family privacy when implementing national, local, and corporate digital solutions.

In the context of the formation of a system of guarantees for the observance of the information rights of natural persons participating in litigation, Regulation 2019/881 of the European Parliament and of the Council of April 17, 2019, on the European Union Agency for Cybersecurity (ENISA) and on the certification of cybersecurity of information and communication technologies, as well as the repeal of Regulation (EU) 526/2013 (the Cybersecurity Act) (hereinafter referred to as Regulation 2019/881) (EU Regulation 2019/881, 2019) is of great importance.

Unlike the acts of EU legislation on cybersecurity, which were adopted by the European Parliament until 2018, Regulation 2019/881 introduced a mechanism for ensuring cybersecurity in accordance with the rules for preventing threats during the design of information systems rather than protecting against them and countering them. For this purpose, the European Cybersecurity Certification Framework has been created, which also applies to the means of digital transformation of justice, in particular, those created on the basis of artificial intelligence technologies. Due to the legalization of this approach to cybersecurity in the EU, the EU Regulation has created a common mechanism for the implementation of such guarantees for the protection of the rights of individuals from the risks of misuse of artificial intelligence technologies, such as accountability and controllability of algorithmic systems used in the field of justice to authorized court officials, protection of the rights of personal data subjects from disproportionate and uncontrolled use personal data by artificial intelligence, the inadmissibility of external interference in decision-making algorithms, prevention of discrimination of individuals by intelligent systems on any grounds that can identify a person, prevention of conflict and competition between artificial intelligence integrated into national judicial information and telecommunication systems in various forms, etc.

Developing the approach laid down by Regulation 2019/881 to ensuring the cybersecurity of information and telecommunications systems using artificial intelligence, on December 14, 2022, the Council of the EU approved Directive (EU) 2022/2555 on measures for a high common level of cybersecurity in the Union, amending Regulation (EU) 910/2014 and Directive (EU) 2018/1972, as well as repealing Directive (EU) 2016/1148 (NIS 2 Directive) (EU Directive 2022/2555) (hereinafter referred to as Directive 2022/2555). Directive 2022/2555 introduces measures aimed at achieving a high common level of cybersecurity in the Union to improve the internal market's functioning.

It should be noted that in accordance with Directive 2022/2555, the rule of transition from the protection of information infrastructure facilities to cyber resilience has been legalized, a separate group of provisions has been identified regarding the standardization of IT products, IT services, and processes that cover various areas of application of artificial intelligence in terms of compliance with

modern cybersecurity requirements. To achieve this goal, the European framework for certification of solutions based on artificial intelligence technologies for compliance with cybersecurity requirements has been improved. At the same time, EU Member States are obliged to further implement international ISO standards related to cybersecurity, in particular in the field of the use of artificial intelligence technologies in the administration of justice.

Thus, Directive 2022/2555 specified a number of provisions of EU Regulation 2019/881 that relate to the standardization and certification of IT solutions based on artificial intelligence technologies for cyber resilience, jurisdictional aspects of countering cyber threats, as well as requirements for guarantees of compliance with information rights in the implementation of innovative technologies.

Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation) (EU Regulation 2016/679, 2016), which provides for a broad system of guarantees of information rights of individuals related to the automated processing of their personal data, including the scope of artificial intelligence.

The guarantees of information rights in the field of artificial intelligence for the purposes of justice provided for by the General Data Protection Regulation cover the right of the personal data subject to know about the purpose, grounds, and means of personal data processing, the conditions of such processing, to consent to its implementation, or to object to such processing, except for cases when it is carried out to perform the tasks assigned to them by authorized state bodies. These guarantees also include protection against automated decision-making against the subject of personal data without informing him/her, the right to be forgotten (deletion of data about the subject of personal data from information and telecommunication systems), the right to object to profiling using artificial intelligence, in particular, in connection with the search for signs that may affect an individual when the court makes a decision taking into account the recommendations of artificial intelligence, the right to clarify data about oneself included in court case materials that can be used for processing using artificial intelligence, etc.

In accordance with the General Data Protection Regulation (EU Regulation 2016/679, 2016), these and other guarantees of the rights of personal data subjects are ensured through the mandatory implementation in the activities of personal data controllers of the rule on the need for mandatory data protection methods for the secure design of information systems and proper, secure processing of personal data.

Thus, EU law has formed a legislative mechanism for observing the information rights of individuals participating in litigation based on the design of safe, controlled, and non-discriminatory solutions based on artificial intelligence and approaches to the transparent, voluntary, informed use of such technologies in litigation, provided that human rights and freedoms are prioritized compared to the advantages of using artificial intelligence.

In the context of actualization in Ukraine, the work on the formation of the legislative framework for the development and application of artificial intelligence, the continuation of judicial and legal reform, the legislative consolidation of guarantees of observance of the information rights of individuals – participants in the judicial process in the use of artificial intelligence is an important condition for innovative transformations of national justice.

When further implementing the EU experience on these issues, it is important to cover changes in national legislation, both jurisdictional and instrumental, and ethical aspects (Zaiarnyi, p. 37, 2022).

In other words, the Verkhovna Rada of Ukraine is tasked with creating the legal basis for developing and applying artificial intelligence technologies in various spheres of public life. One of the ways to solve this problem may be the adoption of the Law of Ukraine "On the Basic Principles of the Development and Application of Artificial Intelligence Technologies". It is within the framework of this legislative act at the level of a separate article that guarantees compliance with information rights, particularly of individuals who use artificial intelligence technologies, can find their special consolidation. At the same time, it is relevant in view of the peculiarities of judicial proceedings by courts in different jurisdictions, supplementing the Law of Ukraine "On the Judiciary and the Status of Judges" with a separate article, "Application of Artificial Intelligence technologies in the activities of courts of Ukraine." The provisions of this article may cover the main directions, conditions, and principles of the use of artificial intelligence technologies by courts, guarantees of observance of the rights of participants in court proceedings when using artificial intelligence technologies, the consequences of violation of regulatory requirements for the use of this technology, etc.

In general, using artificial intelligence technologies in the justice field has more advantages than disadvantages. Potential risks can be avoided if the technology is properly enforced and ethical and legal principles are followed.

Conclusions and recommendations. The study of the peculiarities of the formation and implementation of guarantees of observance of the information rights of individuals – participants in litigation in the EU Member States gives us grounds to formulate the following conclusions and recommendations:

1. In terms of its functional potential, artificial intelligence has significant potential for optimizing court processes, including automated distribution of cases, forecasting the results of consideration, and analyzing judicial practice.

2. The benefits of using artificial intelligence primarily include speeding up procedures, reducing corruption risks, and improving access to justice.

3. EU legislation establishes an extensive system of guarantees of information rights of individuals in connection with the use of artificial intelligence, in particular, in the field of justice. These guarantees include both positive obligations of the EU Member States regarding the legislative consolidation of information rights and guarantees of their exercise by individuals in court proceedings, but also negative obligations to establish exclusive grounds for restricting these rights. By their content, these guarantees are related to the right to non-interference in private and

family life, the right to protection from automated court decision-making, the safe, voluntary, and informed use of artificial intelligence technologies to access information about the state of administration of justice, etc.

4. EU legislation is currently being developed by defining in the EU Regulation on Artificial Intelligence general guarantees of human rights in the application of artificial intelligence. At the same time, special guarantees of compliance with certain categories of information rights of individuals in connection with the use of artificial intelligence are provided at the level of acts of the European Parliament, which regulate certain types of information relations.

4. In general, the model for the implementation of guarantees of information rights in relations related to the use of artificial intelligence, enshrined in EU legislation, is based on a combination of approaches to the safe, controlled design of artificial intelligence and its responsible, ethical, transparent and voluntary application to individuals – parties to the litigation.

6. In order to improve the system of guarantees of information rights of participants in litigation when using artificial intelligence technologies, an important task is to develop the necessary legislative framework. In our opinion, it can be formed by the draft Law of Ukraine "On the Basic Principles of the Development and Application of Artificial Intelligence in Ukraine", separate additions to the Law of Ukraine "On the Judiciary and the Status of Judges", current procedural codes in terms of regulating the main directions, principles, conditions and procedures for the use of artificial intelligence in the activities of courts throughout Ukraine.

7. The State Judicial Administration of Ukraine's adoption of the procedure for using artificial intelligence technologies by courts and court apparatuses in their work is also considered justified. It is in this document that the requirements of the directions, functions, and model of artificial intelligence, which will be integrated into the Unified Judicial Information and Telecommunication System of Ukraine, the principles of its functioning, the conditions for user authorization, requirements for cybersecurity, compliance with the rights of participants in the litigation, LLP can be specified.

8. It is also important to continue activities on introducing European certification frameworks for cybersecurity components of artificial intelligence and international standards for developing and using relevant technology for justice purposes.

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DEVELOPMENT OF RENEWABLE ENERGY SOURCES IN UKRAINE: OPPORTUNITIES, BARRIERS AND PROSPECTS

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Abstract. The article is devoted to the study of the development of renewable energy sources in Ukraine, with an emphasis on the opportunities, barriers and prospects of this process. In the context of current energy security challenges, in particular due to the country's dependence on imported energy resources and the need to ensure stable energy supply in the context of global changes, renewable energy is becoming particularly important. Ukraine has significant potential for the development of energy sources such as solar, wind, hydropower, and biomass. Thanks to favorable natural conditions, including high levels of insolation and wind resources, Ukraine has the potential to build large-scale solar and wind power plants. However, in order to realize these opportunities, it is necessary to improve the legislative and regulatory framework, as well as to stimulate the development of investment attractiveness in the renewable energy sector. According to the data, the share of renewable energy sources in Ukraine's energy system in 2023 was 22%, which is a significant achievement, although this figure still lags behind the European average. However, the development of renewable energy faces challenges, in particular, due to the lack of effective market pricing mechanisms and technical difficulties. The article pays special attention to legislative initiatives that promote the development of renewable energy sources, in particular the "green tariff" and amendments to the laws of Ukraine in recent years. In particular, the Law of Ukraine "On Amendments to Certain Laws of Ukraine on Restoration and Green Transformation of the Energy System of Ukraine" is an important step in the market transformation of the sector, meeting European standards and creating conditions for sustainable development of renewable energy. These measures are expected to contribute to the country's energy independence and ensure compliance with international sustainable development goals, in particular, achieving carbon

neutrality by 2060. The article emphasizes the importance of formulating state plans for the development of renewable energy sources, which will increase the share of energy from renewable sources to 27% by 2030 and ensure the long-term development of this sector in Ukraine.

Keywords: renewable energy sources, energy security, green tariffs, energy investments, legislative framework, international standards.

Problem statement. The current energy landscape of Ukraine reflects an important transformation caused by the need to move towards sustainable development and reduce dependence on traditional energy sources, in particular coal and gas. Renewable energy sources (RES) play an important role in this transformation, as they not only ensure energy security, but also contribute to reducing greenhouse gas emissions and preserving the environment. In recent years, Ukraine has made significant progress in expanding its renewable energy infrastructure, particularly solar and wind power, which opens up new opportunities for economic growth and the development of innovative technologies. However, despite these achievements, the country faces a number of challenges, such as the need to modernize energy grids, political and economic barriers, and restrictions on financing renewable energy projects. In view of these factors, the development of renewable energy sources in Ukraine requires a comprehensive approach, including improving public policy, attracting investment, and developing infrastructure.

An analysis of recent research and publications on the development of RES in Ukraine demonstrates the importance of scientific developments in this area. In this context, L. Kvasniy, I. Drozd, and S. Voloshanska argue that the use of RES and modern innovative technologies allows not only to optimize costs but also to minimize environmental impact. Building an energy-efficient economy requires the combined efforts of government agencies, the business environment, and civil society. According to scientists, rising energy efficiency standards not only pose new challenges but also open up ample opportunities to implement innovative solutions and stimulate progress. At the same time, investing in research, development of advanced technologies and popularization of energy-saving practices contributes to the formation of an environmentally safe and sustainable world focused on the well-being of future generations [1, p. 357]. At the same time, K. Prieb emphasizes that in order to increase investment in the development of RES in Ukraine, it is necessary to introduce various forms and methods of attracting financing. This includes active participation in international programs of grant, technical and other specialized support, the use of state and municipal budgetary assistance, the development of energy service companies, the creation of specialized loan products in the energy sector, the issuance of green bonds, and the promotion of self-financing by energy consumers. An important step to ensure a stable investment flow is to improve the state policy in the field of RES, which should be aimed at creating favorable conditions for investors, increasing their motivation and ensuring the stability of their activities [2, p. 115]. For his part, P. Pucenteilo notes that the development of renewable energy sources is a key element of the modern energy strategy, which

aims to ensure long-term stability, energy independence and environmental sustainability. The use of such energy sources contributes to the diversification of energy supplies, reduces vulnerability to economic and political crises, and opens up new opportunities for the growth of national economies. For Ukraine, this direction is strategically important and can become the basis for modernization of the energy infrastructure and integration into the European energy community [3, p. 68]. A team of scientists, in particular O. Yara, O. Artemenko, Y. Zhuravel and N. Lytvyn, emphasize that the development of energy-saving technologies and RES will help improve environmental performance, reduce environmental damage and reduce emissions. Therefore, it is important to implement an effective energy policy, improve the regulatory framework and attract investments in these areas [4].

The purpose of the article is to study the development of RES in Ukraine with a focus on the opportunities, barriers and prospects of this process.

The main material is presented. The development of RES in Ukraine is of particular relevance in the context of current energy security challenges. The country's dependence on imported energy resources and the need to ensure a stable energy supply in the context of global economic and political changes increase the importance of transition to alternative energy sources. Renewable energy sources, such as wind, solar, river flow, biomass, and geothermal energy, can significantly reduce dependence on traditional energy resources and reduce the negative impact on the environment. In particular, Ukraine has favorable conditions for the development of wind and solar energy due to its large areas with high insolation and wind resources, which allows for the installation of powerful solar and wind power plants. At the same time, realizing these potentials requires the development and improvement of the legislative and regulatory framework, promotion of investment attractiveness, and support for relevant technological innovations.

According to UkraineInvest [5], before the full-scale invasion, the share of renewables in Ukraine's energy system was 8.1%, and the country was a world leader in the development of this sector. In 2019, Ukraine was among the top ten leaders in terms of renewable energy growth and ranked sixth in terms of investment attractiveness in the green energy sector. Over the past ten years, more than USD 12 billion has been attracted to the Ukrainian renewable energy sector. As of 2023, the share of renewables in Ukraine's electricity production, including large hydroelectric power plants, reached 22%, while in Europe this figure is 42%. Before the war, the installed capacity of RES reached 9.9 GW, including 2 GW of wind energy, 6 GW of solar energy, and 0.2 GW of biomass. At the beginning of 2024, this figure was 8.7 GW. Despite the challenges of the war, more than 1400 new RES facilities were connected in 2023, 182.3 MW of wind and about 500 MW of solar power plants were commissioned. Ukrainian businesses have invested about $150 million in solar energy development. It stipulates that Ukraine's long-term goals are to reduce greenhouse gas emissions by 35% from 1990 levels and achieve carbon neutrality by 2060 by replacing coal energy with renewable sources. Since 2009, a "green tariff" has been in place to encourage private owners to install their own power generating facilities to sell electricity to the state. The feed-in tariff rate in 2024

is EUR 0.117 per 1 kWh. Private companies are actively deploying solar panels, wind turbines, and small hydro plants, contributing to the sustainable development of the energy sector.

In view of these achievements, it is important to note that the period from 2014 to 2023 was characterized by an active growth in the volume of installed capacity and electricity production from renewable sources. This was made possible by government incentives, such as the feed-in tariff model introduced in accordance with the Law of Ukraine "On Alternative Energy Sources" [6]. However, the support system had its limitations, in particular due to the lack of market-based pricing mechanisms and feedback. This has led to a number of economic and technical problems that require policy improvements and the introduction of new market instruments to stimulate the development of renewable energy sources in Ukraine.

Given these challenges, it is important to note that the Law of Ukraine "On Alternative Energy Sources" [6] is one of the most important legal acts that defines the legal framework for the development of alternative and renewable energy sources in Ukraine. This legislation is of strategic importance for the country, as it establishes the legal, economic and social framework for promoting the use of renewable energy sources such as solar, wind, hydro, biomass and geothermal energy. According to this law, the state provides legal protection for investors in renewable energy by offering incentives in the form of tax breaks, state subsidies and compensation to companies operating in this sector. One of the main goals is to reduce Ukraine's dependence on traditional energy sources and reduce the negative impact on the environment by reducing greenhouse gas emissions. The law also provides for the development and implementation of state programs and projects aimed at developing renewable energy sources in different regions of the country. This allows optimizing the energy infrastructure and using environmentally friendly sources for electricity and heat production. Despite the numerous achievements in the RES sector in Ukraine, the realities and challenges faced by this sector require immediate resolution. Insufficient funding, technical difficulties, and other obstacles create a need for further optimization of the legal framework to stimulate faster development of renewable energy.

In response to these challenges, a Memorandum of Understanding was signed to resolve problematic issues in the renewable energy sector in Ukraine [7]. It provided for a reduction in feed-in tariffs by investors, as well as state guarantees for the stability of payments and debt repayment. These agreements were enshrined in the Law of Ukraine "On Amendments to Certain Laws of Ukraine on Improving the Conditions for Supporting the Production of Electricity from Alternative Energy Sources" No. 810-IX [8], which came into force in 2020.

In 2023, the Verkhovna Rada of Ukraine adopted Law No. 3220-IX "On Amendments to Certain Laws of Ukraine on the Restoration and Green Transformation of the Energy System of Ukraine" [9], which became an important step in improving the conditions for the development of renewable energy sources. The law laid the groundwork for a market-based transformation of the sector that meets European standards and provides for the creation of conditions for further

sustainable growth of renewable energy. The main provisions of the law are aimed at stimulating the use of innovative mechanisms in the renewable energy sector. In particular, it introduces the development of a system of direct contracts between renewable electricity producers and consumers, creates a register of guarantees of energy origin, and introduces new support mechanisms, such as the Net billing model for active consumers. These steps are aimed at ensuring transparency and competitiveness of the renewable electricity market. An important innovation was the identification of new market participants, including active consumers and aggregators, as well as the possibility for renewable electricity producers to leave the balancing group of the guaranteed buyer, which allows them to sell electricity independently and receive a market premium. To ensure the sustainability of the sector, the legislation has been adapted to the best international practices, including the flexibility of auction models for supporting energy producers that take into account load profiles, specific hours of the day for support, and the possibility of combined construction of renewable energy facilities with energy storage. These measures create the preconditions for the integration of innovative technologies and the effective functioning of the green energy market, which is an important step towards Ukraine's energy independence and compliance with global sustainable development goals.

The Law of Ukraine "On Amendments to Certain Laws of Ukraine on Restoration and Green Transformation of the Energy System of Ukraine" [9] is part of a broader strategy that includes the implementation of the National Renewable Energy Action Plan until 2030 [10]. For its part, the Action Plan and the measures envisaged in it should become the basis for achieving sustainable development of the RES sector in Ukraine. The expected results of its implementation are crucial for consolidating long-term growth trends and ensuring energy independence in the face of global changes. Thus, the implementation of these provisions will help strengthen the country's energy independence and security, as well as the decarbonization of the energy sector, industry, and transport, which will have a positive impact on the overall environmental situation. Among the important tasks is the formation of medium-term state plans for the development of renewable energy, which will determine the scale of technology implementation, the need for investment, and create a favorable legal environment. In particular, the implementation of European legislation in this area will be the basis for optimizing regulatory frameworks and increasing the share of renewable energy in total consumption to at least 27% by 2030. An important component is to attract investments, the latest technologies and intellectual resources for the development of the industry, which will help create new jobs, increase the competitiveness of the national economy and ensure a balanced fuel and energy structure. Another priority is the development of sustainable renewable energy that does not harm biodiversity and natural ecosystems. Taken together, these measures create the preconditions for Ukraine's long-term sustainable development, laying down strategic guidelines for improving energy efficiency, environmental responsibility and economic stability of the country.

The National Renewable Energy Action Plan until 2030 [10] and the measures envisaged therein should become the basis for ensuring the sustainable development of the RES sector in Ukraine, as their implementation will create the basis for long-term growth trends in the energy sector and increase the country's energy independence in the face of global changes. In this context, RES development programs at various levels play an important role, actively promoting the growth of this sector by ensuring the integration of innovative technologies and attracting investments. They also help to reduce environmental risks, which is an important step towards preserving natural resources and achieving the sustainable development goals set at the national level.

For example, at the local level, such programs often include initiatives for the introduction of small and medium-sized renewable energy sources, which allows communities to reduce energy dependence and improve the environment by reducing greenhouse gas emissions. For example, such programs can encourage the installation of solar panels or wind turbines, which stimulates the development of green energy at the local level. At the national level, government programs can include feed-in tariffs, financial incentives for businesses investing in renewable energy, and the creation of infrastructure to integrate these technologies into the country's overall energy grid. In Ukraine, for example, "green" tariffs were introduced, which significantly contributed to the growth of investments in solar and wind energy as part of the strategy to achieve energy security and reduce CO2 emissions. At the same time, the international level includes multilateral agreements and commitments, such as the Paris Agreement [11] (ratified by Ukraine in 2016), which encourage countries to switch to RES. In view of the above, RES development programs at various levels create the necessary legal and financial framework to ensure sustainable growth of renewable energy, ensuring more efficient use of natural resources and reducing the negative impact on the environment.

Summarizing the above, we should highlight the prospects for the development of renewable energy, noting that in Ukraine this process has great potential in the context of martial law and growing pressure on the country's energy infrastructure. Given the strategic importance of energy security and stability of energy supply in the face of global and local challenges, the development of RES in Ukraine can be a key factor in reducing dependence on imported energy resources and ensuring energy independence.

For example, we note that Ukraine has significant potential for wind and solar energy development due to its natural resources - high levels of insolation and favorable wind conditions, which allow for the installation of powerful solar and wind power plants. The development of these energy sources should become part of the country's energy security strategy, as they can not only reduce environmental impact but also mitigate the risks associated with traditional energy resources.

Over the past decade, Ukraine has already seen an active increase in installed renewable energy capacity, in particular through instruments such as the feed-in tariff. However, further development requires improvement of the legal and regulatory framework, in particular through the development of new market-based

pricing mechanisms and the integration of innovative technologies. Implementation of new market instruments, such as a system of direct contracts between producers and consumers of renewable energy, as well as the use of the Net billing model, will increase the efficiency and competitiveness of the RES market.

The laws adopted in 2020-2023, including Law of Ukraine No. 3220-IX on the Green Transition of the Energy System, laid the foundation for market transformations in the RES sector and are in line with European standards. They provide for attracting investments, supporting technological innovations and developing new energy market models that should contribute to the growth of RES by 2030.

The prospects for RES development in the context of the national strategy also envisage achieving energy independence and sustainable development through the integration of European legislation and increasing the share of RES in total energy consumption to 27% by 2030. The strategic development of this industry provides not only economic benefits but also environmental benefits, as it ensures decarbonization of the energy, transport and industry sectors, which, in turn, will improve the environmental situation in the country.

Conclusions. Thus, we note that the development of RES in Ukraine is becoming increasingly important in the context of current energy security challenges, in particular due to dependence on imported energy resources and the need to ensure stable energy supply. Ukraine has a significant potential for wind and solar energy development due to favorable natural conditions, but realizing this potential requires improvement of legislative and investment policies. In recent years, there has been an active growth in the volume of installed renewable energy capacity, but there is a need to improve market mechanisms and further support investment in the sector. Legislative initiatives, such as the feed-in tariff, stimulate the development of renewable sources, but they have limitations that require further optimization. Government steps, including memorandums and new legislative initiatives, are aimed at creating conditions for market transformation of the sector and integration of innovative technologies. In particular, the introduction of new support mechanisms and the adaptation of legislation to European standards have significant potential to ensure the sustainable development of Ukraine's energy system and achieve energy independence.

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LEGAL REGULATION OF INTERNET RESOURCES: THE PRINCIPLES OF A HUMANISTIC APPROACH

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The introduction of new information and communication technologies is the basis of socio-economic and scientific and technological progress – the informatization of society [1]. In particular, in the Law of Ukraine «On Basic Principles of Information Society Development in Ukraine for 2007-2015» it is recognized that one of Ukraine's main priorities is the desire to build a people-centered, open to all and development-oriented information society in which everyone can create and accumulate information and knowledge, have free access, use and share it, in order to to enable everyone to realize their full potential, promoting social and personal development and improving the quality of life.

Instead, the development of the information society not only opens up great opportunities, but at the same time creates serious problems, in particular: standardization of information dissemination activities on the Internet; formation of legal conditions to ensure the objectivity and reliability of information; improving the legal requirements for compliance with professional ethical standards by journalists working on the Internet, etc [2, 3 and others].

Interest in this topic is becoming particularly acute given the great potential of information networks to influence the basic institutions of the state and society, in particular, information security [2, 4 and others]. Thus, in the Information Security Strategy of October 15, 2021, which (Strategy) was approved by the Decree of the President of Ukraine dated December 28, 2021 No. 685/2021, determined the purpose of the Strategy: to strengthen the capabilities to ensure the information security of the state, its information space, support with informational means and measures of social and political stability, state defense, protection of state sovereignty, territorial integrity of Ukraine, democratic constitutional system,

ensuring rights and freedoms every citizen. Achieving the specified goal will be carried out, in particular, by introducing effective mechanisms for detecting, fixing, restricting access and/or removing from the Ukrainian segment of the Internet information, the placement of which is restricted or prohibited by law.

It is clear that in a democratic state governed by the rule of law, where the priority of human and civil rights and freedoms is recognized, any restrictions are subject to denial. For example, most online media outlets and their professional associations strongly oppose mandatory online media registration due to warnings about potential threats to free speech [5]. However, it should not be forgotten that the rights and freedoms of some end where they begin to harm the rights and freedoms of others. Thus, the French Declaration of the Rights of Man and of the Citizen of 26.08.1798 refers to the inalienable and sacred human rights to freedom of opinion, opinion, speech and the press, which, at the same time, are protected by «the threat of responsibility for the abuse of this freedom». Well-known American scientist and Nobel laureate M. Friedman quotes a judge of the Supreme Court of the United States: «My freedom to wave my fists must be limited by the proximity of your chin» [6]. The European Network and Information Security Agency (ENISA) has been established within the European Union (EU), and the Council of Europe Convention on Cybercrime (2001), the Privacy and Telecommunications Directive (2002), the Network and Telecommunications Directive information security (2016) [4, p. 116].

So, sooner or later the problem of regulatory regulation of information dissemination on the Internet will have to be solved [7]. For example, in the fourth paragraph of item 12 of the resolution of the Plenum of the Supreme Court of Ukraine of 27.02.2009 № 1 «On judicial practice in cases of protection of dignity and honor of an individual, as well as business reputation of an individual and legal entity» unreliable information that tarnishes the dignity, honor or business reputation, posted on the Internet on an information resource registered in the manner prescribed by law as a media outlet, the courts should be guided by the rules governing the activities of the media.

The textbook «Hybrid Warfare and Journalism» emphasizes that the traditional means of disseminating information (print media, radio and television) have recently been joined by the Internet, which has supplemented them with blogs and social networks, ensuring prompt response to events and interactivity. It is natural that the Internet is gradually becoming a leader and a leading place among popular sources of information, because searching for data online is simple, convenient and takes much less time than going to the library, reading newspaper archives or even watching TV. Due to the constant development of information computer technology, the society has formed a positive public opinion about the usefulness of the Internet, and the rapid expansion of its technical capabilities and audience has led to the emergence of many information services and resources. Searching for information via the Internet has become the prerogative not only of ordinary users, but also of government officials, businessmen and commercial organizations. After all, timely receipt of information can bring considerable profits and tangible benefits [8, p. 97]

O. Vergolyas [9] points out that the on-line social network, in terms of information and communication technologies, creates the conditions for the use of much more tools of information and psychological influence than off-line due to

technological capabilities for placement and delivery of audio and video information to the addressee. On-line networks have a much wider range of options for placing and delivering information to the recipient of various kinds (video, pictures, photos, text, audio). The speed of information dissemination in the on-line network is much higher than in the off-line network due to the simplicity of transmission and broadcasting. In addition, it is worth noting that the production, distribution and delivery to the recipient of information products (content) for distribution in the on-line network requires much less human and material resources than in the on-line network, especially for due to the speed of distribution and extremely low costs for the animation of information materials [9].

At the same time, many authors, especially those dealing with information security issues, pay attention to the dangers that create informational influences on the Internet on the individual, society, state [10-25 and others].

So, M.B. Kubyavka notes that humanity receives information from the Internet, press, radio and television every day. Being for a long time in the world of symbols detached from reality, a person can even go against their own interests, because reality is pushed to the background, playing a subordinate role [14, p. 34].

G. Pocheptsov is of a similar opinion, pointing out that man is really becoming more and more defenseless, because he remains the same as before, and the technologies of influence are constantly moving forward. The mass man, who was generated by the consequences of mass communication and mass culture, is exposed today to such volumes of influence as never before. The Internet has not created a preserve free from such technologies, but simply new technologies of influence [18].

I.M. Sopilko emphasizes that information progress has become a tool for enslaving people with information technology. In fact, in the information society there is an absorption of personality by information technology, in which people for the sake of material benefits obtained from participation in various network systems, lose spiritual freedom and personality in general [22].

In the same regard, M. Borshchev warns that the hidden danger of the Internet and similar interactive cybernetic systems is that, unlike the TV viewer, the network user is subjectively confident in the freedom of information choice, in the uncontrollability of their behavior by other entities. network. Unlike the print media and television, the Internet allows the use of an unusually wide range of informational stimulation of the consciousness and subconscious of the individual.

Given these positions, many authors draw attention to the possibilities of using the Internet in information and information-psychological wars. So, M.B. Kubyavka points out that there are currently many uses of the global computer network Internet in the interests of information conflict [14, p. 38]. Today, the Internet, the scientist continues, is being used more and more actively and in the interests of information confrontation between the parties to various conflicts. It creates ample opportunities for the formation of public opinion; influence on political, economic and military decisions; actions on the information resources of the enemy and the dissemination of specially prepared information (misinformation) [14, p. 40].

The Internet allows us to use the enormous potential of the network to transform public consciousness. Waging an information network war has become

more convenient than ever: there is a possibility of uncontrolled posting of negative and, anonymous messages that will quickly spread on the network. In the traditional media, it has always been possible to identify the author of defamatory material, as well as to prove, by obtaining a refutation through the court, that the information posted is false. It will not be possible to do this on the Internet, or the process will take a disproportionate amount of time, which will benefit the enemy in the information war. It is well known that for many subjects the Internet has long become the only way to obtain information, therefore the organizers of any information war do not pass by such a powerful tool and widely use it for their own purposes. Moreover, a number of specific features of the Internet make it especially attractive for organizers of information battles.

In particular, R. Khardel and V. Vyzdryk study the possibilities and effectiveness of the use of mass media and mass media on the global Internet as a tool to influence historical consciousness in the course of information confrontation between the Russian Federation and Ukraine. The authors conclude that modern online media, both traditional (online publications, TV channels) and non-traditional (video hosting, social networks) are widely used in the process of information confrontation to influence public consciousness, including such a component, as historical consciousness. Such influence is carried out by careful selection, dosing of information and stereotypes of its perception, which are brought to certain target groups, and at mass and long influence pass to the category of beliefs [24, p. 100, 106].

At a time when Russia's military aggression against Ukraine continues, countering the information attacks that accompany it is especially important. The mass distribution of fakes by the Russian media and Internet trolls belongs to the arsenal of the struggle against the former Soviet republics, and now independent states, in order to return them to the status of Russian colonies [25, p. 296].

V.F. Zagurska-Antonyuk emphasizes that one of the mechanisms for resolving the issue of counteracting information threats is restricting access to information or distorting it in the process of «information warfare», which has become a «terrible» reality in modern Ukraine-Russia geopolitical relations. But here this author points out that such restrictions may «be unacceptable in civilized democratic societies that strive for democratic values» [26].

Thus, in modern conditions the problem of normative regulation of information dissemination on the Internet becomes especially urgent.

Individual issues of legal regulation of Internet resources were considered by the authors in a monograph [27].

According to Article 34 of the Constitution of Ukraine, everyone is guaranteed the right to freedom of thought and speech, to free expression of their views and beliefs. Everyone has the right to freely collect, store, use and disseminate information orally, in writing or otherwise – at their discretion. The exercise of these rights may be restricted by law in the interests of national security, territorial integrity or public order in order to prevent riots or crimes, to protect public health, to protect the reputation or rights of others, to prevent the disclosure of confidential information or to maintain authority and impartiality of justice.

In general, this approach is fully in line with the Council of Europe Convention for the Protection of Human Rights and Fundamental Freedoms of 1950

(hereinafter – European Convention). In particular, Article 10 of the Europe Convention «Freedom of expression» formulates a «European standard» of guarantees of freedom of expression and their restrictions:

1. Everyone has the right to freedom of expression. This right shall include freedom to hold opinions and to receive and impart information and ideas without interference by public authority and regardless of frontiers. This Article shall not prevent States from requiring the licensing of broadcasting, television or cinema enterprises.

2. The exercise of these freedoms, since it carries with it duties and responsibilities, may be subject to such formalities, conditions, restrictions or penalties as are prescribed by law and are necessary in a democratic society, in the interests of national security, territorial integrity or public safety, for the prevention of disorder or crime, for the protection of health or morals, for the protection of the reputation or rights of others, for preventing the disclosure of information received in confidence, or for maintaining the authority and impartiality of the judiciary.

These formulations reflect the dualism of rights and responsibilities in the field of freedom of expression, according to which (dualism) these rights are guaranteed, but may be subject to certain restrictions.

According to Part 1 of Art. 2 of the Law of Ukraine (hereinafter – the Law) «On Information», the basic principles of information relations in Ukraine, in particular, are defined: the reliability and completeness of information; legality of receiving, using, disseminating, storing and protecting information; protection of a person from interference in his personal and family life. According to Part 1 of Art. 3 of the Law «On Information», one of the main areas of state information policy is to ensure information security of Ukraine.

According to paragraph 13 of the Basic Principles of Information Society Development in Ukraine for 2007-2015, approved by the law of the same name dated 09.01.2007 № 537-V, information security – a state of protection of vital interests of man, society and the state, which prevents harm due to: incompleteness, untimeliness and unreliability of the information used; negative information impact; negative consequences of the use of information technology; unauthorized dissemination, use and violation of the integrity, confidentiality and availability of information.

In the above-mentioned in the Information Security Strategy of October 15, 2021, information security is also associated with blocking and removing from the information space of the state, in particular from the Ukrainian segment of the Internet, information that threatens the lives and health of Ukrainian citizens.

Thus, information security in a democratic state is considered in the unity of interests of protection of human and state security, therefore, the relevant restrictions for some directly enhance the security of others.

The general rule for handling information is set out in Part 2 of Art. 302 of the Civil code of Ukraine: «*The physical person who disseminates the information, is obliged to be convinced of its authenticity. An individual who disseminates information obtained from official sources (information of public authorities, local governments, reports, transcripts, etc.) is not obliged to verify its authenticity and is not responsible in case of refutation. An individual who disseminates information obtained from official sources is obliged to refer to such a source*».

Therefore, information obtained through official sources from the authorities, in particular, the official pages of such authorities on the Internet, is considered reliable, and the individual should not be responsible for the consequences of the dissemination of such information. In all other cases, it is the individual who disseminates the information who is responsible for its dissemination. This applies even in cases where an individual disseminates information already created by someone else, in particular through the Internet [28].

Thus, these rules provide an expanded list of grounds for release from liability for disclosure of unverified information: both by sources of information and by the circle of distributors – not only received from officials of the authorities, but also received from other media, and not only by distributors - individuals, but also directly to the media. Let's call these norms the presumption of reliability of information. In the context of widespread practice, when many media outlets, including print media, distribute (reprint) materials from Internet resources, in such media, in the case of claims to the authenticity of such materials, there is a temptation to refer to Art 302 of the Civil code of Ukraine, equating materials reprinted from the Internet resource to those received from the media and/or news agencies.

Thus, in the decision of 05.05.2011 of the European Court of Human Rights (hereinafter – the ECHR) in the case «The newspaper "Pravoe Delo"and Shtekel v. Ukraine» considered the situation when this newspaper (editor-in-chief – Shtekel L.I.) reprinted information materials from the Internet, which later turned out to be unreliable. The newspaper was prosecuted for this. In their appeal to the ECHR, the applicants referred to the above under Art. 42 of the Law «On print media (press) in Ukraine» presumption reliability of information.

Having considered this situation, the ECHR (according to the text of the decision – the Court) came to the following conclusions (highlighted by the authors):

«*60. The Court observes that the publication at issue was a verbatim reproduction of material downloaded from a publicly accessible internet newspaper. It contained a reference to the source of the material and comments by the editorial board, in which they formally distanced themselves from the content of the material.*

61. Ukrainian law, specifically the Press Act, grants journalists immunity from civil liability for verbatim reproduction of material published in the press. The Court notes that this provision generally conforms to its approach to journalists' freedom to disseminate statements made by others.

62. However, according to the domestic courts, no such immunity existed for journalists reproducing material from internet sources not registered pursuant to the Press Act. In this connection, the Court observes that there existed no domestic regulations on State registration of internet media and that, according to the Government, the Press Act and other normative acts regulating media relations in Ukraine did not contain any provisions on the status of internet-based media or the use of information obtained from the Internet.

64. Nevertheless, having regard to the role the Internet plays in the context of professional media activities (see paragraphs 29-32 above) and its importance for the exercise of the right to freedom of expression generally, the Court considers that the absence of a sufficient legal framework at the domestic level allowing journalists to use information obtained from the Internet without fear of incurring sanctions seriously hinders the exercise of the vital function of the press as a «public watchdog». In the Court's view, the complete

exclusion of such information from the field of application of the legislative guarantees for journalists' freedom may itself give rise to an unjustified interference with press freedom under Article 10 of the Convention».

(https://zakon.rada.gov.ua/laws/show/974_807 – text in Ukrainian

https://www.menschenrechte.ac.at/orig/11_3/Pravoye.pdf – English text)

Thus, according to the ECHR, the legal regulation of Internet resources as a media should be, and this not only does not restrict the freedom of information, but, conversely, increases the level of guarantees for users of this information. At the same time, the level of responsibility of such electronic media for violating the legislation in the field of media is increasing. At the same time, this issue in Ukraine is still unresolved [5], and the lack of such regulation allows Internet resources, even those who consider themselves respectable, to completely ignore any rules of journalistic and publishing ethics [29].

Given the legal unresolved issue of registration of Internet publications, the Center for Democracy and the Rule of Law considers it most optimal to obtain additional guarantees of journalistic activity for employees of such publications by registering Internet publications as an information agency, which facilitates access to recognition of agency employees as journalists [29].

At the same time, it should be directly emphasized that the alleged «confusion» with the information disseminated with reference to sources on the Internet is not in fact a particular confusion. Such schemes are purposefully used to legalize unreliable (fake) information.

In particular, G. Pocheptsov [16] reports that Gleb Pavlovsky, presented by «Komsomolskaya Pravda» as a «veteran of information wars», pays special attention to various Internet projects, considering them as an ideal tool for launching the necessary stories into the mass consciousness. He says: «Traditional media are responsible for the information they disseminate. Rumors transmitted via the Internet are anonymous. But then newspapers and television get the opportunity to link to the Internet. That is, there is a real laundering of so-called "black" information. Previously, this "black" information could only be made "gray" – to distribute it on the sidelines, no more. Now it is possible to launder any "misinformation" completely».

O. Mitenko also emphasizes that the lack of mechanisms of state control over the dissemination of information through Internet sites causes a rapid increase in the volume of socio-political content (anonymous, the authenticity of which is questionable, provocative and openly illegal), which are duplicated by traditional domestic media with a link to the Internet [15].

O. Golub reports that many experts emphasize the danger of using social networks as a source of information, because the so-called new media is one of the most common ways of spreading false information and fakes. It is noted that in recent years, more and more classic media use social networks as primary sources. The responsibility lies with journalists who are lazy or inexperienced and do not check the accuracy of information. Then this unverified information gets on television and spreads to a mass audience. There is no doubt about the danger of spreading false information in the context of the information war, which is part of the hybrid war that Russia is waging against Ukraine. This affects not only the civilian population of Ukraine, but also demobilizes the military defending their country. All these technologies have long been tested. Research shows that people

consider the most important topics and issues that are actively covered and discussed in the media. In this way, it is possible to purposefully adjust the perception of society – in fact, to form a new reality [30].

According to the StopFake website, false news is spread primarily by the Russian media. Ukrainian media, on the other hand, can spread lies if they inadvertently check the source of the information. That's why journalists should be especially careful to check information from social networks, so as not to become carriers of fakes. It is the journalist's responsibility to verify and process the information received. In fact, this is how traditional media should differ from social networks and aggregator sites [30].

A. Bely conducted a study of the sources of fake ratings of Ukraine on economic reliability or security and/or residence. For example, initially the site «Numbeo» published «information» about the allegedly extremely low rating and stalemate criminogenic situation in Ukraine against the background of all European countries. And some cities, such as Odessa and Dnipro, take 12th and 13th place in this anti-rating of cities. The «news» received quite a serious response in the media.

However, the study showed that the published ranking lacks data sources and their verification. There are no calculation criteria and quantitative indicators.

It is reasonable to assume, says the author of the study, that the reason for such fake news is the artificial creation of the idea of investment unattractiveness of Ukraine, because investment, especially long-term, in a country with low security and stability is unlikely. The biggest risks in Ukraine, in terms of financial stability, took place in 2015. At the same time, according to generally accepted world ratings, Ukraine has a positive development trend. So, authoritative rating agencies show that despite the ongoing armed aggression and destabilizing influence by the Russian Federation, the related arms trafficking, the COVID-19 pandemic and the associated economic recession, thanks to the efforts of the Ministry of Internal Affairs and other law enforcement agencies 65 % of the population considers Ukraine a safe place to live. This is not much worse than the United Kingdom (70 %), Italy and France (71 %), Bulgaria (72 %). In 2017, the EU average was 82 %. We should not forget, the author of the study points out, that the involvement of some media outlets that reproduce fake ratings with dubious sources is one of the key factors in waging a fierce hybrid war against Ukraine [31].

Thus, in conditions when supporters of freedom of speech oppose attempts to introduce legal regulation of information dissemination on the Internet and consider it an attack on these freedoms, it is proposed to «softly» introduce legal regulation of media on the Internet in Ukraine, when state registration of Internet media carried out on a voluntary basis, but the absence of such registration deprives such unregistered disseminators of benefits and preferences inherent in registered media.

In addition, the issue of liability for the comments of third parties, which (comments) are distributed on web resources, remains unresolved by law. In this regard, it should be noted that in the decision of 05.09.2016 in the case «Delfi AS v. Estonia» (Application № 64569/09) the ECHR recognized the lawfulness of the national courts of Estonia to prosecute the information portal for offensive comments from readers under the article . In particular, the ECHR has identified the following (reverse translation from the Ukrainian language):

«110. The Court notes, first of all, that the opportunities that the Internet provides for users to express themselves through the content they create are a unique platform for them to exercise their right to freedom of expression. This fact is indisputable and the Court has recognized it in its previous judgments. However, along with these benefits, there are also certain risks. Defamatory and other statements of a clearly illegal nature, including hostile statements, and those that incite violence can spread like never before worldwide in a matter of seconds, and sometimes remain steadily present on the Internet...

Given the need to protect values , which underlie the Convention, and equal respect for the rights guaranteed by Articles 10 and 8 of the Convention, a balance must be struck which preserves the essence of both rights. Thus, while the Court recognizes the possibility of obtaining important benefits for the exercise of the right to freedom of expression via the Internet, the Court also takes into account that prosecution for defamatory and other unlawful statements must, in principle, remain an effective remedy in the event of violation of personal rights…

162.… having regard to… the extremely harsh nature of the comments in question, the fact that they were left in response to an article published by the applicant company on its professionally managed information internet portal on a commercial basis, the lack of action taken the applicant company to remove, without delay after their publication, these comments, which contained hate speech and calls for violence, and to ensure a real possibility of bringing the authors of such comments to justice, as well as the moderate nature of the sanction applied to the applicant company. conclusion that, in imposing liability on the applicant company, the domestic courts had relied on appropriate and sufficient grounds, taking into account the discretion given to the respondent State. Therefore, the sanction applied did not constitute a disproportionate restriction on the applicant company's right to freedom of expression. There has accordingly been no violation of Article 10 of the Convention».

(https://cedem.org.ua/library/delfi-as-proty-estoniyi-delfi-as-v-estonia/ – text in Ukrainian)

The arguments and proposals presented in this article are embodied by the authors in the draft law «On Amendments to Certain Legislative Acts of Ukraine Concerning the Protection of the Rights of Citizens and the State in the Sphere of Information Relations» developed by them. The purpose of the bill is to amend some legislative acts of Ukraine on the protection of the rights of citizens and the state in the field of information relations. Adoption of the bill should create conditions for «soft» introduction of legal regulation of mass media on the Internet in Ukraine, when state registration of Internet media is carried out on a voluntary basis, but the lack of such registration deprives such unregistered disseminators of benefits and preferences inherent in registered media. In particular, the proposed to predict reservations that the presumption of accuracy of information applies only to information obtained from registered Internet media. We believe that this will increase interest in such voluntary registration.

In addition, we believe that the level of trust in the disseminated information can be increased by the mandatory placement on the main Internet page of the Internet media of the source data of the publication: 1) the name of the edition; 2) founder (co-founders); 3) surname and initials of the editor (editor-in-chief); 4) addresses of the editorial office, publisher; 5) series, number and date of issuance of the state registration certificate; 6) publisher (co-publishers).

At the same time, it is proposed to increase the level of guarantees for persons against whom information is disseminated that violates the rights and interests of such persons, namely: to establish that such persons have the right to respond even if information is reproduced from other media. This will help to reduce such negative manifestations, when many media outlets are conspired to carry out information attacks on certain individuals or institutions with mutual reference to each other.

As currently in Ukraine there is a practice of registration of Internet media according to the model of news agencies, it is proposed to regulate the registration of Internet media according to the model to News Agencies (taking into account the peculiarities of information dissemination on the Internet).

In addition, in order to increase the level of information security of the state, it is proposed to introduce a provision on the inadmissibility of promoting or promoting the aggressor state and its authorities, representatives of the aggressor state and their actions that create a positive image of the aggressor state, justify or recognize legitimate occupation. Ukraine, in the Laws of Ukraine «On Information» and «On Information Agencies», where these rules do not currently exist.

Conclusions. The above study leads to the following results.

1. The European Court of Human Rights does not consider the adoption of national regulations on the state registration of online publications to be a violation of freedom of expression. Provided that it is properly regulated (in accordance with the requirements of the Convention for the Protection of Human Rights and Fundamental Freedoms), such registration, on the other hand, strengthens journalists' guarantees and expands the range of information, to which the presumption of authenticity can be applied, – while increasing the responsibility of such Internet distributors for disseminating inappropriate information.

2. It is proposed to legislate "soft" registration of Internet media, when state registration of Internet media is carried out on a voluntary basis, but the absence of such registration deprives such unregistered disseminators of benefits and preferences inherent in registered media. In particular, it is proposed to supplement the Law of Ukraine "On Media" with caveats that the presumption of authenticity of information applies exclusively to information obtained from registered Internet mass media. We believe that this will increase interest in such voluntary registration. A corresponding draft of the Law is proposed.

3. It is recommended that registered Internet mass media post information about their official registration as a news agency on their own website, which will increase the level of trust in the information they disseminate.

4. The European Court of Human Rights recognized that the owners of web portals can be responsible for the comments of third parties, which (comments) are spread on web resources and contradict the principles of protecting the dignity and honor of an individual, as well as the business reputation of an individual and a legal entity. In this regard, it should be noted that in the decision dated September 5, 2016 in the "Delfi AS v. Estonia" case, the European Court of Human Rights found the national courts of Estonia to hold an information portal liable for offensive comments of readers under the article. Therefore, the dissemination of false

information through the Internet media may lead to its responsibility even if this Internet media is not its author.

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PATENTING OF INVENTIONS CREATED WITH THE USE OF ARTIFICIAL INTELLIGENCE: REGULATORY ISSUES

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Abstract. The article, based on intellectual property analytics tools, analysis of international and national patent legislation, investigates the problems of inventions created using artificial intelligence (AI): patent landscape, patenting dynamics, patent activity in the field of AI technologies, analyses the features of patentability examination of inventions in various jurisdictions (EPO, Germany, China, USA, Japan) and judicial practice on this issue. The main provisions of the draft law "On Amendments to the Law of Ukraine "On Protection of Rights to Inventions and Utility Models" regarding the regulation of relations arising in relation to inventions and utility models created using artificial intelligence" are considered. It is concluded that the law "On Protection of Rights to Inventions and Utility Models" excludes computer programs from patented objects. It is recommended to implement the norms of the EPC Guidelines on computer-implemented inventions in the Rules for the Preparation, Filing and Examination of Applications for Inventions and Applications for Utility Models, which do not reflect these aspects.

Keywords: intellectual property, invention, inventor, artificial intelligence, patenting, patentability examination

Statement of the problem. According to a study by the World Intellectual Property Organization (WIPO) in its Technology Trends 2019 – Artificial Intelligence series, since the emergence of artificial intelligence (AI) in the 1950s, nearly 340,000 AI-related patent applications have been filed and over 1.6 million scientific publications have been published. They cover various AI technologies for numerous functional applications of AI in a wide range of AI applications. This has been facilitated by the development of highly sophisticated models inspired by the original neural network, which include several hundred million parameters and are capable of sifting through huge amounts of unstructured data (video, text, big data and data coming from various sources), structuring them and finding patterns.

According to the analysis of applications for inventions in the field of AI conducted by WIPO, the most common applications of AI are computer vision technologies, including pattern recognition systems. Significant areas of application of AI technologies include: information systems (automatic classification, search and analysis from databases); machine translation of natural languages; telecommunications (computer networks, Internet, radio and television broadcasting, etc.); transport (avionics, autonomous vehicles, driver/vehicle recognition systems, traffic management systems); life sciences and medicine

(bioinformatics, bioengineering, biomechanics, pharmaceuticals, genomics, neuro- and cardiorobotics, etc.) [1].

The importance of the above-mentioned areas of application of AI technologies has been growing in recent decades. The main objects of intellectual property (IP) in the field of AI are inventions and utility models. AI in legal regulation is considered as a new challenge for the economy and the legal system, a new phenomenon that has a multiplier effect, a legal phenomenon in the structure of legal relations, a new object for legal regulation [2].

Analysis of recent research and publications. Research in the field of AI regulation is traditionally interdisciplinary. A significant contribution to the study of the AI phenomenon was made by foreign scientists: A. Turing, D. Barratt, R. Abbott, E. Horwitz, N. Bostrom, I. Musk, D. Dyson, K. Kelly, R. Kahlo, P. Asaro, E. Voinikanis, V. Vindzhe, A. Nevenglovsky, K. Schwab, R. Markevich, P. Morkhat, Ukrainian scientists are actively engaged in this issue - G. Androschuk, O. Baranov, V. Bryzhko, O. Doroshenko, O. Vyshnevsky, O. Vinnyk, K. Efremova, Y. Kapitsa, M. Karchevsky, O. Kostenko, M. Kyzym, V. Pylypchuk, O. Radutny, L. Rabotyagova, N. Savinova, E. Kharitonov, O. Kharitonova, A. Shevchenko, I. Yanenkova and others. However, the dynamics of changes in this area, the complex, interdisciplinary nature of the issues require new research, in particular on the patenting of inventions created using AI.

Purpose and objectives: The main purpose of the work is to investigate the theoretical and practical aspects of invention and patenting of inventions created using AI in various jurisdictions, in particular, the dynamics of patenting, patent activity in the field of AI technologies, examination of the patentability of inventions implemented on a computer, carried out by leading IP offices, and to develop recommendations for Ukraine.

Presentation of the main research material. Modern scientific and technological development has led to the fact that AI has become capable of generating and creating various works - science, technology, literature and art. The creation of AI works is an integral area of activity in the modern digital economy. These circumstances bring to the forefront the problems of recognizing authorship when creating AI works, the possibility of authors managing their rights and using mechanisms for legal protection of IP objects.

Systematization of patent applications for inventions using AI.The aforementioned WIPO study on AI proposed a transparent classification of patent applications for solutions that use AI, depending on the scope of their application. The first category of patent applications on AI is the so-called "core AI". In applications of this type, the desired scope of legal protection includes directly developed techniques, mathematical algorithms or the construction of computational models. All this can be found in the International Patent Classification (IPC) in classes G06N. The second category is patent applications grouped by a more specialized level of application. They concern the functional application of AI. At this level, it can be seen that AI is developing in classes that cover the reproduction of the inherent qualities of the human mind and body of

machines. These include, for example, computer vision, natural language processing and speech processing, motion, decision-making, prediction, etc. Solutions of this kind are placed in classes G06F17, G10L, G06F19, G06K9 of the IPC. The third category of AI applications is patent applications for solutions used in specific industries. Here, the emphasis is on the technical effect of a highly specialized application, rather than on a specific example of implementation. Applications of this type already exist in every class of the IPC, i.e. in medicine, military affairs, industry, transport, energy, even in the field of business methods. Therefore, every patent attorney or patent office expert, regardless of their field of activity, will sooner or later encounter the topic of AI.[1]

Patent activity in the field of AI technologies. The three offices with the most AI applications are the United States, China, and Japan, accounting for almost 78% of all applications filed. The PCT procedure is a highly sought-after international filing system. One third of all AI patent applications are filed in other jurisdictions after the first filing, and approximately 8% are filed in five or more jurisdictions at once. According to statistics from these three leading offices, 40% of patent applications first filed in Japan and 32% of patent applications first filed in the United States are subsequently filed in other countries, forming so-called patent families. At the same time, only 4% of patent applications first filed in China are subsequently filed in other jurisdictions [1]. Over the past five years, patent activity in the field of AI technologies has increased eightfold worldwide – the number of granted patents increased from 10,000 to 80,000 in 2021. The leader is the American company IBM - 1813 applications for inventions. Among the American companies that are actively developing research projects using neural networks, there are also Google (1167), Adobe (580), Intel (1131) and Microsoft (948). In China, Baidu (317), Tencent (306), Huawei (272) are in the lead, in Europe - Bosch (590) and Siemens (333). This follows from the data of a study conducted by IFI Claims. The most active registration of rights for inventions in the field of computer systems based on biological models or neural networks. The greatest growth in the number of patents issued was shown by the patent class that combines computer systems based on biological models or using physical material of biological origin to perform calculations.

According to their research, Facebook is more likely to patent instant messaging technologies, Google - developments in the field of speech and voice analysis, Sony - gaming systems with financial rewards, Adobe - innovations in the field of e-commerce. IFI Claims specialists combined all the technological areas analyzed above with a number of related ones, such as computing, games and digital information transmission. This allowed us to identify companies that make the greatest contribution to the development of the so-called metaverse. Among them, first of all, large technology corporations were found to have filed the largest number of applications: Microsoft - over 120, Samsung - 70, IBM - 53, as well as Intel, Apple, LG, Adobe, Sony, Facebook, Google, Baidu, as well as media production studios such as Disney - 28 and Universal - 16 [3].

WIPO Policymaking on IP and AI. In 2020, 22 WIPO Member States, over 100 organizations, and over 100 individuals submitted comments and suggestions

on the WIPO Draft Issues Paper on Intellectual Property Policy and Artificial Intelligence [4]. Member States that provided comments included Germany, China, Russia, the United States, France, Switzerland, and Japan. The U.S. submission came from the Office of the Copyright Registry; no submissions from the U.S. Patent and Trademark Office were published. Organizations that provided comments and suggestions also included the American Bar Association (ABA), the International Association for the Protection of Intellectual Property (AIPPI) and several of its member groups, the American Intellectual Property Law Association (AIPLA), the Intellectual Property Owners Association (IPO), the International Trademark Association (INTA), the Recording Industry Association of America (RIAA), and national IP associations such as CIPA (UK), GRUR (Germany), and the Japan Intellectual Property Association. Suggestions were also submitted from universities and research institutes, as well as from groups such as Creative Commons, Knowledge Economy International, and the Wikimedia Foundation. A wide range of companies spanning Europe, India, China, and the United States submitted comments. These included BlackBerry, Robert Bosch, Ericsson, Huawei, IBM UK, Intel, Merck, Philips, Siemens, and Tencent, as well as several law firms and IP service providers.

One of the areas highlighted in the draft issue document concerned invention and patent ownership "in the case of inventions autonomously created by AI". The following questions were considered. Should the law allow or require that an AI be named as the inventor in the application? And who should be registered as the owner of a patent related to an AI application? However, the EU submission states that "the question of invention/ownership should include fundamental issues regarding the identification by IP offices of inventions created by or with the help of AI, the possibility of assigning the name of the inventor to a legal entity and the possible consequences for society of the corresponding rights to AI". Thus, analyzing the current EU legislation on the regulation of relations arising from IP objects created by AI technology, we can conclude that the result obtained with the help of AI technology is regarded by EU legislation as an object of IP rights, meaning a creative result. However, the European Parliament emphasizes that at the moment the regulation of relations in the field of AI is under development, and all related issues, including the status of the result of intellectual activity created by AI, are not yet reflected in special provisions of the legislation.[5]

The issues raised in the draft WIPO issue paper concerning invention and patent ownership "in the case of inventions autonomously generated by AI" were resolved in court cases on DABUS patent applications. The filing in 2018 of patent applications in various countries around the world for "Food Container" with the applicant Steven L. Thaler as the applicant and the AI system "Device for Autonomous Bootstrapping of Unified Sentience (DABUS)" as the inventor sparked an international debate on the concept of authorship under patent law. The applicant Steven L. Thaler emphasized that DABUS is the true inventor of the invention because the invention was autonomously generated by AI, and that it would be dishonest to claim otherwise. DABUS applications have been rejected in most countries at the departmental level and

on appeal in court, and are still pending in several countries. The German Federal Patent Court is the latest to rule on DABUS applications filed in 17 different jurisdictions around the world under the Artificial Inventor project. This ruling will help resolve the issue of AI as inventor, as it allows a human to be named as the inventor and also recognizes the creative contribution of AI [6].

A key issue for the IP field, raised by the DABUS applicant, is whether patent law allows AI to be identified as an inventor instead of a human. Overall, the applicant failed to convince the courts and IP offices with his argument, despite the differences in national legislation and patent systems. At the same time, it becomes clear that the digital environment will continue to pose new questions for patent law, including who the inventor can be and what rights he will have to a patent, so it is necessary to improve the legislation and develop the IP system in interaction with AI technologies, as well as support and encouragement for inventors [7]. At the current level of technological development of AI, according to WIPO experts, an important part of the process of creating inventions related to AI technologies is the activity of people, therefore, this process is proposed to be considered by focusing on the creative, inventive idea of a person, as follows: identifying the problem and developing a solution are carried out by people, and AI technology is used simply to verify, automate, adapt or generalize the solution proposed by a person; identifying the problem is carried out by people, and developing the solution is carried out with the assistance or under the guidance of AI technology.

Based on the above, the following conclusion is made. If the process of creating an invention includes the use of AI, provided that the person participating in this process qualifies as an "inventor" in accordance with applicable law and contributes to the concept of the claimed invention, this person will be the inventor of this invention, whether it is an AI programmer, an AI developer, an AI user, or someone else [8]. Due to the fact that the issue of regulating relations arising in relation to inventions created using AI is not resolved in national IP legislation, scientists from the Research Institute of Intellectual Property of the National Academy of Sciences of the Republic of Kazakhstan turned to the analysis of foreign legislation and doctrinal positions on this issue. The European Parliament resolution 2015/2013 (INL) of 16 February 2017, which includes the Charter of Robotics (European Parliament resolution of 16 February 2017 with recommendations to the Commission on Civil Law Rules on Robotics (2015/2103(INL)), provides that the current system of legal regulation of IP issues applies to robotics, and a technology-neutral approach to IP rights [9]. In particular, legal protection for objects created by AI systems should be granted taking into account neutral legal personality, because AI systems are primarily driven by humans.

In April 2019, the European Commission published a Directive on the ethical approach to the development of AI for industry to consider. The main provisions of the document are that AI should be designed to support human subjectivity, and that AI systems and their outputs should be "human-centric, aimed entirely at serving humanity and the common good, in order to contribute to the improvement of human conditions and freedoms". The European Parliament's resolution of 12

February 2019 on a comprehensive European industrial policy on artificial intelligence and robotics (2018/2088(INI)) notes that artificial intelligence will remain a useful tool for collaborative action to increase human productivity and reduce errors. Technological creativity generated by AI technologies should be protected by IP rights to encourage investment in this form of creativity and increase legal certainty for citizens, businesses and inventors, who are currently among the most frequent users of AI technologies [10].

The International Association for the Protection of Intellectual Property (hereinafter -AIPPI), which is a leading international organization engaged in the development and improvement of legal regimes for the protection and enforcement of intellectual property, unites more than 9,000 members representing more than 125 countries of the world, conducted a study related to the legal protection of inventions created using AI. The following issues were considered, in particular: can AI as an "artificial person" be considered an inventor or co-inventor; does the current patent legislation allow us to resolve the issue of determining the inventor and intellectual property rights for inventions created using AI. The study was based on the following definition of AI: artificial intelligence is an object (or a collective set of interacting objects) capable of receiving input data, interpreting and learning from such input data, and also demonstrating consistent and flexible behavior and actions that help the object achieve a specific goal or task over a certain period of time [11].

A total of 36 reports were received from national groups and independent members. We will analyze in more detail these reports, as well as a summary report prepared by AIPPI General Correspondent Jonathan P. OSHA and his assistants. All experts expressed the opinion that doctrinally, national and international legislation in the field of legal protection of inventions recognizes as an inventor only a person whose intellectual, creative activity created an invention, that is, AI is not a subject of intellectual property rights, an application for an invention created using AI will be rejected from the formal requirements for the sole reason that AI was indicated as an inventor or co-inventor. The indication of AI in the application materials should be considered only for informational purposes without any consequences for intellectual property rights, in particular intellectual property rights to this invention [12]. According to the independent members (Chinese Taipei), in order for AI to be considered an inventor or co-inventor, it must have legal personality, namely: to be independent, that is, not just a tool that is completely dependent on a person; to be able to participate in the creation of legal relationships; to be able to protect its intellectual property rights from infringement.

In addition, most jurisdictions assume that inventors are the first owners of an invention unless the invention was created as a service. Both ownership and employment are legal concepts that require legal personality. Since, under the current general legal framework, AI cannot legally own property or use it in the legal sense of the term, there is no basis for recognizing AI entities as “artificial persons” with the right to authorship, or for granting AI any legal personality [13]. In summary, it can be noted that the vast majority of experts are of the opinion that

AI should not be considered an inventor or co-inventor, and that AI should not be listed as an inventor or co-inventor in an invention application.

In all jurisdictions, a creative or intellectual conception of an invention or contribution to it is a condition that directly or indirectly passes through the possibility of identifying a person as an inventor. The nature of the actual contribution in the conception phase of the invention must be creative or "intellectual" in nature. Hence, human participation in the conception phase of the invention is required, which goes beyond the provision of abstract ideas, on the one hand, and the simple implementation of ideas proposed by others, on the other. Therefore, when creating inventions using AI, what is important is the real process that takes place in the human mind and leads to the result specified by the human. In our view, the necessary contribution to the process of creating an invention may include the formulation of an original idea, the statement of a technical problem that led to and guided the process of creating the invention. At the same time, it is unlikely that today or even in the near future the said inventions will not be associated with a person who made such an intellectual contribution that distinguishes the invention from the prior art, and thereby allows the identification of the person-inventor.

The Reference Document on Patents and New Technologies, prepared by the WIPO Standing Committee on the Law of Patents, provides the following justification for the claim that AI cannot be an inventor under current patent law. Thus, Article 4-ter of the Paris Convention for the Protection of Industrial Property states that the inventor has the right to be named as such in a patent. This provision concerns what is called the "moral" right or the personal non-property right of the inventor to be named as such in a patent granted for his invention in all countries of the Paris Union. It is generally understood that the inventor may waive such right, unless national law provides otherwise. Since the Paris Convention does not contain a definition of inventor, the identification of the inventor(s) and the procedure for exercising such personal non-property right are regulated by each country in accordance with its current law. Although not all national laws define the term "inventor", given that personal non-property rights are one of the fundamental rights associated with patent rights, it is believed that there is a general presumption that the inventor is a human. If this presumption is valid, the logical consequence may be that, regardless of the level of contribution of AI to the concept of the invention, AI is not an inventor.

It should be noted that the creation of AI as a result of intellectual activity differs from the creative process of a person, because AI, as a rule, cannot randomly generate texts completely independently. AI does this on the basis of the works and images it has studied, while it processes and uses the works of other persons (people). Therefore, according to scientists, one of the important areas of improving intellectual property legislation in this area should be to ensure more effective protection of the rights of such persons [14]. The final AIPPI Resolution "Study Question – Patents. Inventorship of inventions made using Artificial Intelligence" (Resolution 2020 – Study Question – Patents Inventorship of inventions made using

Artificial Intelligence), in particular, recommends that: an invention should not be excluded from patent protection solely because AI contributed to this invention. Regardless of whether AI was used in the development of the invention, a natural person should be considered an inventor … if he or she made an intellectual contribution to the inventive concept. If an individual has developed an AI algorithm to solve a predetermined problem that is effectively solved by an invention, such an individual should be considered the inventor of the invention [15]. As for the sphere of intellectual property in Ukraine, Article 421 of the Civil Code of Ukraine (hereinafter referred to as the Civil Code of Ukraine) directly states that the subjects of intellectual property rights are: the creator (creators) of the object of intellectual property rights (author, performer, inventor, etc.). The term "creator" in this article is similar in meaning to the term "author" of the object of intellectual property rights. The creator (author) is an individual whose creative work created the object of intellectual property rights. The result of intellectual, creative activity can only be created by an individual [16].

In addition, the Law of Ukraine "On the Protection of Rights to Inventions and Utility Models" dated 15.12.1993 No. 3687-XII as amended on 14.10.2020 (hereinafter referred to as the Law of Ukraine) in Article 1 provides the following definition: an invention (utility model) is the result of intellectual, creative human activity in any field of technology. The objects of an invention (utility model) in accordance with Part 2 of Article 459 and Part 2 of Article 460 of the Civil Code of Ukraine may be a product (device, substance, etc.) or a process in any field of technology. In paragraph 2.3.1. "Rules for drawing up and submitting an application for an invention and an application for a utility model", registered with the Ministry of Justice of Ukraine on February 27, 2001 under No. 173/5364 (hereinafter referred to as the Rules) it is noted that a product as an object of technology is a material object as the result of human activity. A process as an object of technology is an action or set of actions performed on products and other material objects with the help of at least one product and aimed at achieving a certain technical result. In light of the above, it is necessary to assess whether the current regime of legal protection of inventions in Ukraine can provide a satisfactory definition of inventors in situations where the created invention is related to AI activities. Will the identification as an inventor of a person who participated in the process of creating an invention related to AI activities be sufficient to fulfill the requirement to define the inventor in accordance with the regime of legal protection of inventions?

As for the inventor's creative contribution, in accordance with clause 6.6.2. of the Rules, the description of the invention (utility model) discloses in detail the technical problem to which the invention (utility model) is directed and the technical result that can be achieved when implementing the invention (utility model). The technical problem, as a rule, consists in creating an object whose characteristics meet the specified requirements. The technical result is understood as the discovery of new properties or improvement of the characteristics of known properties of the object of the invention (utility model) that can be obtained when implementing the invention (utility model) (clause 6.6.3. of the Rules). Sharing the opinion that the

formulation of the problem is a necessary element in the process of inventive creativity, that the invention itself is the unity of two necessary components, the problem and its solution, scientists have proposed the following definition of the concept of "inventive problem". An inventive problem is the formulation in the process of technical creativity of the requirements for the invention, the basis of which is the social need realized by the inventor, translated into the language of technical problems. It was noted that sometimes the greatest creative efforts are required precisely when formulating a problem, and not when solving it, therefore, the creative formulation of a problem sometimes also includes its solution. In the process of finding a solution to a problem, the inventive task is repeatedly transformed, transformed in the inventor's mind, translated from one plane of its generalization to another. This peculiar part of the creative process serves as a kind of catalyst for the search, which ultimately leads to the solution of the problem. From the point of view of the creative process, the inventive task is a dynamic concept that is not frozen in time, although it has a stable element in the form of an unsatisfied social need [17].

It follows that the formulation of a technical problem by a person in accordance with the Rules is an intellectual contribution to the inventive concept of the invention, and such a person should be considered the inventor of the invention created using AI. In addition, when creating inventions using AI, a person can develop AI algorithms, design AI for a specific purpose, collect data and train AI with this data, and also use the trained AI to solve a specific technical problem. However, according to the current legislation of Ukraine, it is not possible to assess the creative contribution of the inventor to the invention created using AI. In view of the above and taking into account the AIPPI Resolution 2020 — Issues for Study — Patents Invention of Inventions Created Using Artificial Intelligence, the above-mentioned researchers of the Research Institute of Intellectual Property of the National Academy of Legal Sciences of Ukraine Androshchuk G.O., Doroshenko O.F., Rabotyagowa L.I., Tverezenko O.O. developed a draft Law of Ukraine "On Amendments to the Law of Ukraine "On Protection of Rights to Inventions and Utility Models" (regarding inventions and utility models created using artificial intelligence)", which would allow identifying the inventor of an invention created using AI, noting his creative contribution to the creation of such an invention.

At the same time, Article 1 of the Law of Ukraine introduces a definition of AI as the ability of designed systems to acquire, process and apply knowledge and skills. The definition is provided in accordance with the ISO/IEC TR 24028:2020 Standard "Information Technology — Artificial Intelligence — Review of the Reliability of Artificial Intelligence". In order to determine the inventor's creative contribution to the creation of an invention using AI, Part 2 of Article 8 "Inventor's Right" is worded as follows: "If an invention (utility model) is created using artificial intelligence, the natural person who made a creative contribution to the creation of such an invention (utility model) is the inventor. An inventor is a natural person who, in particular, but not limited to: 1) used an artificial intelligence algorithm to create an invention (utility model), if the characteristics of the created invention

(utility model) meet the requirements set by this person; 2) developed an artificial intelligence algorithm to solve a technical problem defined by this person, which is solved by an invention (utility model) created using such an algorithm; 3) selected data or a data source for training an artificial intelligence algorithm, if such data or a data source is selected for the purpose of solving a technical problem solved by an invention (utility model) created using such an algorithm; 4) selected or generated data, or selected a data source for input into a trained artificial intelligence algorithm, if such data or a data source is generated or selected for the purpose of solving a technical problem defined by this person, which is solved by an invention (utility model) created using such an algorithm.

Inventors who jointly created an invention (utility model) have the same rights to register an invention (utility model), a secret invention (secret utility model), unless otherwise provided for by an agreement between them. In addition, Article 8 was supplemented with Part 6 of the following content: "Artificial intelligence is not an inventor, even if the invention (utility model) is created using artificial intelligence." It should be noted that according to the Law of Ukraine, an invention created using AI may be protected by a patent for an invention or a patent for a utility model. A patent for a utility model is issued based on the results of a formal examination (examination on formal grounds), during which no research is conducted on the compliance of the utility model with the criteria of patentability (novelty and industrial applicability). When conducting a formal examination, in accordance with Part 9 of Article 16 of the Law of Ukraine, it is only determined to which objects the claimed utility model belongs: to objects protected in accordance with the Law of Ukraine; or to objects that are not subject to legal protection; or to objects that do not correspond to the concept of "utility model" defined in Article 1 of the Law of Ukraine. The above article does not regulate in which cases utility models created using artificial intelligence are protected and in which they are not. Therefore, it became necessary to introduce the following object into Part 3 of Article 6 of the Law of Ukraine to the list of objects that do not correspond to the concept of "invention (utility model)" and to which legal protection does not apply: "a product or process created using artificial intelligence, if it is not possible to determine the creative contribution of an individual to its creation."

In the process of solving a technical problem, AI usually generates a lot of results, so the question arises whether a natural person who selects one result from a large number of results created by AI and recognizes it as a patentable invention should be considered an inventor or co-inventor of the invention. When conducting a study on this issue, AIPPI experts made the following statements. It is impossible not to agree with the opinion of the experts. Based on this, in the developed draft law, the following condition for recognizing a natural person as an inventor was added to Part 2 of Article 8 of the Law of Ukraine: "5) discovered an invention (utility model) in the results generated by the artificial intelligence algorithm when solving a technical problem determined by this person". Making appropriate amendments to the regulatory legal acts of Ukraine that regulate the legal protection of inventions (utility models), in the opinion of the project developers, will allow

protecting inventions created using AI, which will ultimately improve Ukraine's innovation potential and ensure its national security.

Patentability examination of inventions created using AI. The European Patent Office (EPO) has responded to the emergence of AI in patent applications by improving its approach to the patentability examination of inventions using AI. According to Article 52(1) of the European Patent Convention (EPC), European patents shall be granted for any inventions in all fields of technology, provided that they are new, involve an inventive step and are susceptible of industrial application. However, schemes, rules and methods (...) of doing business, as well as computer programs, are not considered to be inventions within the meaning of Article 52(2)(c) EPC) and <…unpatentable to the extent that the application for a European patent or a European patent relates to such an object or activities as such …> Article 52(3) EPC. Artificial intelligence is considered a branch of computer science, and therefore inventions related to AI are considered by the EPO as Computer Implemented Inventions (CII). A CII is an invention that involves the use of a computer, a computer network or another programmable device, where one or more functions are implemented wholly or partly by means of a computer program. If the claimed subject matter includes technical means, it does not become excluded subject matter as such within the meaning of Art. 52(2)(c) and (3) EPC. In such a case, the claimed subject matter is considered to be of a technical nature and is not unpatentable within the meaning of Art. 52(2)(c) and (3) EPC.

The term "computer-implemented inventions" (CII) covers applications relating to computers, computer networks or other programmable devices in which at least one feature is implemented by means of a program. The claims characterizing the CII must identify all features that are essential to the technical effect of the process that the computer program is intended to perform when it is run.

The Guidelines for Examination in the EPO (hereinafter referred to as the EPC Guidelines) for the first time in 2018 for computer-implemented inventions included a section on AI and machine learning (G-II 3.3.1), which are initially defined as computational models and algorithms for classification, clustering, regression and dimensionality reduction. Over the years, case law developed by the EPO Technical Boards of Appeal has clarified the meaning of Article 52 EPC, establishing a stable and predictable basis for the patentability of computer-implemented inventions, including AI-related inventions. These features are reflected in the new EPO Examination Guidelines. The EPO Examination Guidelines (EPC Guidelines), in force since 1 March 2023, regulate the practices and procedures to be followed in various aspects of the examination of European applications. and patents under the EPC and its implementing regulations. The said EPC Guidelines in Part G "Patentability" Section II "Inventions" contain a list of examples of exclusions which explains the difference between what is patentable in the sense of what is not excluded from patentability under Art. 52(2) and (3) and what is not [18].

Terms such as "support vector machine", "reasoning machine" or "neural network" may, depending on the context, simply refer to abstract models or algorithms and thus do not necessarily imply the use of technical means in

themselves. This must be taken into account when examining whether the claimed subject matter is of a technical nature in general (Article 52(1), (2) and (3)). The technical nature of the invention is important when assessing the patentability of computer-implemented inventions, in particular those related to AI (G-II, 3.3.1 Artificial Intelligence and Machine Learning). AI and machine learning are based on computational models and algorithms for classification, clustering, regression and dimensionality reduction, such as neural networks, genetic algorithms, support vector machines, k-means, kernel regression and discriminant analysis. Such computational models and algorithms are inherently abstract mathematical in nature, regardless of whether they can be trained on training data. Therefore, the recommendations given in G-II, 3.3 generally apply to such computational models and algorithms. Artificial intelligence and machine learning find applications in various fields of technology. For example, the use of a neural network in a heart monitoring device to detect irregular heartbeats. The classification of digital images, video, audio, or speech signals based on low-level features (e.g., boundaries or pixel attributes of images) is another typical technical application of classification algorithms. Additional examples are discussed in [19].

The EPC Guidelines provide a collection of hyperlinks to facilitate access to sections of the Guidelines that provide guidance that is particularly useful for searching and examining CII. The collection of sections includes guidance on the assessment of patentability claims, in particular in the case of claims containing technical and non-technical features that are common to CII, as well as sections that teach how to assess features related to Art. 52(2) EPC, as well as sections that describe search and claim practices under Art. 83 and 84 EPC [20]. As AI is a new technology, case law is not yet fully developed and only a few patent offices have issued Guidelines that clarify their practical methods for examination in this area. The revised Guidelines for Eligibility for Patent Subject Matter (2019 Edition) developed by the US Patent and Trademark Office includes one example regarding the patentability of a computer-generated method for training a neural network for face recognition using a series of steps for such training [21]. The China National Intellectual Property Administration (CNIPA) has issued a draft of the Patent Guidelines for Patent Applications Covering AI and Blockchain. The amendments are made to take into account the special nature of the examination of patent applications related to AI, Internet+, big data, and blockchain. When looking for a "technical solution" that can make machine intelligence patentable, the CNIPA suggests considering improvements in algorithms and big data processing, whether the algorithms have certain technical connections to the internal structure of the computer system, and/or improvements in hardware computing efficiency or execution effects. The CNIPA considers increases in data storage size, data transfer speed, and hardware processing speed as evidence of a technical solution required for patentability [22,23].

Appendix A of the Patent and Utility Model Examination Guide published by the Japan Patent Office contains several examples for assessing the inventive step of AI-related inventions, such as: no inventive step because the invention only

systematizes human activity in a particular AI system; no inventive step due to a simple change in the method of evaluating output data based on input data; no inventive step because the change in data for machine learning is a simple combination of known data that has no significant effect; and the presence of an inventive step related to some preliminary preparation of data for training [24].

Patent landscape in the field of artificial intelligence (**AI**). Chinese inventors lead the field in terms of number of inventions, filing the most applications for inventions in the field of generative artificial intelligence (AI), far ahead of inventors from the United States, the Republic of Korea, Japan and India, which are also in the top five. This is according to the WIPO "Generative AI Patent Landscape Report". It is reported that 54,000 AI-related inventions were registered between 2013 and 2023, more than 25% of which were created in the last year. AI allows users to create a variety of content, including text, images, music and computer code, and is the basis of a number of industrial and consumer products, including chatbots such as ChatGPT, Google Gemini or Baidu's ERNIE. Over the past decade, China has produced over 38,000 AI-related inventions, six times more than the second-largest country, the United States. AI is already being used in industries such as life sciences, manufacturing, transportation, security, and telecommunications. In 2023 alone, more than 25% of all AI-related patents worldwide were published, and more than 45% of all scientific papers on the subject were published.[25] However, according to WIPO, patenting does not necessarily correlate with innovation leadership in the field. The United States and China are roughly equal in terms of scientific publication output. However, American papers may be more innovative than Chinese papers because they are cited more frequently.

Patent activity in the field of AI in Ukraine. In 2016–2021, Ukraine received only 16 patents out of 32,0878 or 0.005% of global patents in the field of AI. In total, Ukraine, as a priority country, owns 130 patents, of which 126 patents were obtained in the period 2000–2021. The highest patent activity in Ukraine was observed in 2010–2014. Among these patents, 68 units or 54% belong to “live” (active) patents, and 55 units or 43.7% belong to “dead” (due to non-payment of fees or expiration of their term). Analyzing WIPO patent statistics for Ukraine, we see a small number of patent applications (patent publications by technology) that fall under the categories “Computer technologies” and “IT methods for management”. Thus, between 1980 and 2018, only 740 such applications were published. Compared to the total number of 58,845 published applications, this is 1.26%. [26] The experience of the United States in this area is certainly noteworthy. In the Guidelines for the Examination of the European Patent Office (EPO) regarding computer programs, for the first time in 2018, a section appeared on AI and machine learning (G-II3.3.1), which were initially defined as computational models and algorithms for classification, clustering, regression and dimensionality reduction. Subsequently, an improved version appeared. Ukraine needs to implement the norms of the Guidelines for the U.S. AI and EPO regarding computer-implemented inventions. After all, the new Rules for the preparation, submission and consideration of applications for inventions and applications for utility models, approved by the order of the Ministry

of Economy of Ukraine dated 09.09. 2024 No. 23301, do not reflect these aspects. Only a comprehensive approach (changes to legislation and by-laws, stimulation and improvement of examination of applications for inventions) will make it possible to increase inventive activity in this area.

Conclusions and suggestions for further research. According to the Artificial Intelligence Industry in Eastern Europe report by Deep Knowledge Analytics, Ukraine is among the top three countries in Eastern Europe in terms of the number of AI companies (57 companies) [27]. According to the Oxford Insights and the International Center for Research Development Government AI Readiness Index 2020 study, Ukraine has the largest number of AI technology development companies in Eastern Europe [28]. The scope of AI application in Ukraine is developing rapidly. The market for software development for AI implementation is growing every year, and more and more suppliers offer various AI solutions for business. According to LinkedIn, there are more than 2,000 institutions and software development companies specializing in AI in Ukraine. Among them are globally recognized companies such as Grammarly, Reface, and RingUkraine (SQUAD), so AI should become one of the key drivers of digital transformation and overall growth of the Ukrainian economy. At the same time, one of the tasks set by the government is to enter the top 10 countries with high AI development in the world [29]. However, as noted in the International IP Index Compete for Tomorrow, Ukraine has a small number of inventions related to computer programs in the total number of applications filed and patents issued. Thus, analyzing the WIPO patent statistics for Ukraine, we see only a small number of patent applications (patent publications by technology) falling under the categories "Computer technologies" and "IT methods for management". Thus, between 1980 and 2018, only 740 such applications were published. Compared to the total number of 58,845 published applications, this is 1.26% [30]. There were no changes in 2021. This is surprising, given the launch of the "Diya City" economic free zone and the adoption of the regulatory framework "On stimulating the development of the digital economy in Ukraine". These initiatives are aimed at positioning Ukraine at the forefront of the ICT industry and digital innovation. Thus, while a number of tax and economic reforms have been introduced as part of this legal framework that seeks to stimulate the growth and development of the IT sector, there have been no legislative changes regarding the assessment of the patentability of computer-implemented inventions. It is necessary to implement the norms of the EPC Guidelines on computer-implemented inventions in the Rules for the preparation, filing and examination of applications for inventions and applications for utility models, which do not reflect these aspects. The use of the latest EPO recommendations when drawing up an application for an invention is necessary for the applicant and the expert in the future when considering applications for computer-implemented inventions, in particular those related to AI. They allow, even at the stage of preparation of the application, to correctly indicate what the claimed improvements are and to assess whether there is any technical result that cannot be expected in advance based on the existing state of the art before the date of filing the application. As Yu. Kapitsa

rightly notes, it is necessary to take into account the global phenomenon of the use of AI and the low probability that countries around the world will apply a significant number of different models of protection of rights to such objects. The urgency of inventing an effective form of protection is related to the need to compensate for the investment, time, and effort spent on creating AI systems and/or objects that are created by AI directly or with human participation [31].

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FREEDOM OF SPEECH IN THE CONDITIONS OF HYBRID WARS: INTERNATIONAL EXPERIENCE

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Abstract. The purpose of the article is to study the issue of international standards and foreign experience in ensuring the right to freedom of expression. Research methods: the chosen topic of scientific research requires various scientific methods and approaches to obtain qualitative results. Therefore, the following research methods were used to solve the tasks: analysis; system method; analytical, etc. Results: Freedom of expression is a fundamental human right that must be upheld in democratic societies. Governments unjustifiably restrict freedom of speech, and target journalists, protesters, and others deemed to disagree with the government's views. Today, there is a tendency where, even in Western democracies, laws reduce protest activity and threaten freedom of the press and speech through mandatory metadata storage schemes. Civil societies around the world must be vigilant in protecting freedom of expression. This is necessary to improve people's lives and create and maintain strong, healthy democratic societies. Discussion: The right to freedom of expression is the right to preserve opinions without interference, and cannot be subject to any exception or limitation. However, this right is not absolute, it entails special obligations and may be restricted for several reasons. For example, restrictions may include filtering access to certain websites, calling for violence, or classifying artistic material. The right to freedom of expression extends to any media information, including written and oral communications, mass media, public protest, broadcasting, artistic works, and commercial advertising.

Keywords: human rights, freedom of thought, freedom of expression, protection of rights, enforcement of rights.

Statement of the problem and its relevance. The right to freedom of expression is the right to hold opinions without interference, and cannot be subject to any exception or limitation. However, this right is not absolute; it entails special obligations and may be limited for several reasons. For example, restrictions may concern filtering access to certain Internet sites, calls for violence, or classification of fiction material. In the modern world, artificial intelligence technologies play an increasing role in ensuring or limiting this right. For example, AI algorithms can automatically identify and block content that is subject to banning, or, conversely, help spread information that encourages open discussion. Artificial intelligence is also used to analyze speech on social networks, and its decisions can have a significant impact on the implementation of freedom of expression. At the same time, it is important to ensure that such algorithms operate transparently and do not

violate basic human rights. The right to freedom of expression extends to any form of media, including written and oral communications, mass media, public protest, broadcasting, artistic works, and commercial advertising.

Analysis of research and publications on the problem. The study is based on scientific and theoretical works of domestic and foreign experts in the field of law.

The object of the paper is to study the issue of international standards and foreign experience in ensuring the right to freedom of expression.

Presentation of the main research material. International standards of freedom of expression are enshrined in Article 19 of the Universal Declaration of Human Rights, which states that everyone has the right to freedom of opinion and expression. This right includes the freedom to hold opinions without interference and to seek, receive, and impart information and ideas through any media regardless of frontiers [1].

The International Covenant on Civil and Political Rights (ICCPR) in Article 19 guarantees that: 1. Everyone shall have the right to hold opinions without interference. 2. Everyone shall have the right to freedom of expression. This right shall include freedom to seek, receive, and impart information and ideas of all kinds, regardless of frontiers, either orally, in writing, or print, in the form of art, or through any other media of his choice. 3. The exercise of the rights provided for in paragraph 3 of this article carries with it special duties and responsibilities[1].

It may therefore be subject to certain restrictions, but these shall only be such as are provided by law and are necessary: a) Out of respect for the rights or reputations of others; b) For the protection of national security or public order, or public health or morals [1].

Article 9 of the African Charter on Human and Peoples' Rights stipulates that every individual has the right to receive information and every individual has the right to express and disseminate his opinions within the framework of the law [1].

The European Convention for the Protection of Human Rights and Fundamental Freedoms guarantees in Article 10: 1) that everyone has the right to freedom of expression. This right includes freedom to hold opinions and to receive and impart information and ideas without interference by public authority and regardless of frontiers. This article shall not prevent States from requiring the licensing of broadcasting, television, or cinema enterprises. 2) The exercise of these freedoms, since it carries with it duties and responsibilities, may be subject to such formalities, conditions, restrictions, or penalties as are prescribed by law and are necessary in a democratic society, in the interests of national security, territorial integrity or public safety; for the prevention of disorder or crime; for the protection of health or morals; for the protection of the reputation or rights of others; for preventing the disclosure of information received in confidence; or for maintaining the authority and impartiality of the judiciary American Convention on Human Rights [1].

Article 13 of this normative legal act establishes that: 1. Everyone has the right to freedom of thought and expression. This right shall include freedom to seek, receive, and impart information and ideas of all kinds, regardless of frontiers, either orally, in writing, in print, in the form of art, or through any other media of one's

choice. 2. The exercise of the right provided for in the preceding paragraph shall not be subject to prior censorship but shall be subject to further penalties expressly established by law to the extent necessary to ensure: a) respect for the rights or reputations of others; b) the protection of national security, public order, public health or morals. 3. The right to express opinions may not be restricted by indirect methods or means, such as the abuse of public or private control over newsprint, radio frequencies or equipment used for the dissemination of information, or any other means that impede the transmission and dissemination of ideas. and opinions. 4. Notwithstanding the provisions of paragraph 2 above, public entertainment may be subject to prior censorship by law to regulate access thereto for the moral protection of childhood and adolescence. 5. Any propaganda for war and any propaganda of national, racial, or religious hatred that constitutes incitement to lawless violence or any other similar action against any person or group of persons on any grounds, including race, color, religion, language or national origin, shall be considered offenses punishable by law [1].

The right to freedom of thought and expression is also contained in Article 20 of the International Covenant on Civil and Political Rights (ICCPR) [2]. In addition, Articles 4 and 5 of the Convention on the Elimination of All Forms of Racial Discrimination (CERD) [3], Articles 12 and 13 of the Convention on the Rights of the Child (CRC) [4], and Article 21 of the Convention on the Rights of Persons with Disabilities (CLPD) [5].

General Comment No. 34 [6] of the UN Human Rights Committee on the ICCPR notes that the right to freedom of expression includes, for example, political discourse, commentary on one's own and public affairs, campaigning, discussion of human rights, journalism, cultural and artistic expression, teaching and religious discourse. It also covers expressions that some may consider deeply offensive, verbal as well as non-verbal communications, and all modes of expression, including audiovisual, electronic, and Internet modes of communication.

In terms of Article 19(3) of the ICCPR, the right to freedom of expression contained in Article 19(2) may be subject to certain limitations: "The exercise of the rights provided for in paragraph 2 of this article carries with it special duties and responsibilities. It may therefore be subject to certain limitations, but these shall only be such as are provided by law and are necessary: (a) for respect of the rights or reputations of others; (b) for the protection of national security or of public order (ordre public), or of public health or morals."

Concerning restrictions on the right to freedom of expression under Article 19(2) of the ICCPR, a three-part test is used to assess whether such a restriction is justified: (i) the restriction must be provided by law; (ii) it must pursue a legitimate aim; (iii) it must be necessary for the legitimate aim. (4) This test applies in a similar way to restrictions on the right to freedom of expression under other legal instruments, including the African Charter [7].

Article 19(2) of the ICCPR also provides that the right to freedom of expression applies regardless of frontiers and through any media of one's choice.

General Comment No. 34 further explains that Article 19(2) includes online modes of communication.

In a 2016 resolution, the UN Human Rights Council affirmed that: "The same rights that individuals have offline must also be protected online, in particular freedom of expression, which applies regardless of frontiers and through any media of one's choice, following Articles 19 of the Universal Declaration of Human Rights and the International Covenant on Civil and Political Rights" [8].

In 2016, the African Commission on Human and Peoples' Rights (ACHPR) [9] called on states to respect and take legislative and other measures to guarantee, respect, and protect the rights of individuals to freedom of information and expression through access to internet services. This was complemented in 2019 by the Declaration of Principles on Freedom of Expression and Access to Information in Africa [10] adopted by the ACHPR, which recognizes the role of new digital technologies in realizing the rights to freedom of expression and access to information, and asserts that the same rights that people have offline must be protected online in line with international law and human rights standards.

Although freedom of expression is protected by a significant body of treaty law, it can be regarded as a principle of customary international law, given how frequently the principle is enunciated in treaties as well as other soft law instruments. Most human rights treaties, including those protecting the rights of specific groups such as women, children, and people with disabilities, also make explicit reference to freedom of expression.

It should be emphasized that expression and exchange of opinions increasingly take place online, including through social media platforms, websites, and search engines.

The right to freedom of expression is balanced by the responsibilities of government, the media and technology, and citizens. It is not an unlimited right and is subject to legal limitations. Although the UN General Assembly recognized in December 1948 that freedom of expression is a fundamental right of national protection [11], subsequent international agreements have recognized that there may be limitations on this right. For example, the European Convention on Human Rights (ECHR), adopted in 1950, understood that the right may be limited by law [12]. Article 10 of the Convention states that "everyone has the right to freedom of expression," but this freedom may be subject to limitations for various reasons, including to protect the rights of others.

The exercise of these freedoms, since it carries with it duties and responsibilities, may be subject to such formalities, conditions, restrictions, or penalties as are prescribed by law and are necessary in a democratic society, in the interests of national security, territorial integrity or public safety, for the prevention of disorder or crime, for the protection of health or morals, for the protection of the reputation or rights of others, for preventing the disclosure of information received in confidence, or for maintaining the authority and impartiality of the judiciary.

In the UK, the Human Rights Act 1998 implemented Article 10 of the ECHR into domestic law [13].

UK criminal or civil law applies both online and offline and may be relevant to communications and activities on the Internet. The right to freedom of expression is subject to several restrictions in UK law, including:

The Harmful Communications Act 1988 [14] and the Communications Act 2003 [15], which criminalize "indecent or grossly offensive" communications and threats.

The Public Order Act 1986 [16], which contains offenses for incitement to hatred on the grounds of race, religion, or sexual discrimination,

The Terrorism Act 2006 [17], which criminalizes the publication and distribution of material that could be considered to encourage acts of terrorism.

Further information on laws that may be relevant to freedom of expression can be found in Section 2 of the House of Lords Communications and Digital Technology Committee's report, 'Free for All? Freedom of Expression in the Digital Age [18].

Today, several well-known regulators play a role concerning different forms of online activity in the UK. These include Ofcom, the Competition and Markets Authority, and the Advertising Standards Authority. For example, this may relate to the use of individuals' data or information and tackling misleading or age-inappropriate online advertising.

However, there are concerns about the lack of appropriate regulation, particularly regulation covering social media and search services in the UK. This was highlighted by the government in the explanatory notes to the Online Safety Bill [19], which noted that "currently, most user and search services operating in the UK are not subject to any user safety regulation". The exception is the statutory video-sharing platform regime, which requires service providers to protect individuals from certain harmful content and is enforced by Ofcom.

The government introduced the Internet Safety Legislation to improve regulation, arguing that "in light of the serious harm that online content can cause to users, broader and more comprehensive regulation of online services should be introduced."

At one time, Boris Johnson's government sought to address the issue of freedom of expression online through the Internet Safety Bill [20]. The bill aims to: preserve and enhance freedom of speech online; improve user safety online; improve the ability of law enforcement to combat illegal content online; improve the ability of users to keep themselves safe online; improve public understanding of the harm landscape, etc.

Boris Johnson's government has also set out its strategy for regulating freedom of expression in the digital landscape in several policy documents, including:

"Digital regulation: driving growth and unlocking innovation", published in July 2021. The document sets out the government's overall vision for digital governance. It sets out three aims: promoting competition and innovation, keeping the UK online, and promoting a prosperous, democratic society.

Boris Johnson's government has also set out its strategy for regulating freedom of expression in the digital landscape in several policy documents, including:

"Digital regulation: driving growth and unlocking innovation", published in July 2021. The document sets out the government's overall vision for digital

governance. It sets out three aims: promoting competition and innovation, keeping the UK present in the Internet, and promoting a prosperous, democratic society.

"A New Pro-Competition Regime for Digital Markets: A Consultation Paper" published in July 2021. The government set out its plans to reform the digital market. It included proposals for the Digital Markets Unit (DMU) and how it should work with other regulators. It also proposed that statutory powers be given to the DMU. The DMU was established in non-statutory form within the Competition and Markets Authority in April 2021 to support the rapid establishment of a statutory competition regime for digital markets.

"Online Media Literacy Strategy" published in July 2021. The strategy and accompanying action plan set out the government's three-year plan to coordinate media literacy education and equip users with the skills they need to make safe choices online.

On 22 July 2021, the House of Lords Communications and Digital Committee published its report "Free for All? Freedom of Expression in the Digital Age"[18]. The report focused on how public policy can protect the right to freedom of expression online and how it should be balanced with other rights. It considered: how competition between platforms can be increased to benefit freedom of expression; how the government should ensure that illegal content is removed and legitimate opinions are not censored; how the design of online platforms and digital citizenship education can support inclusive debate and the exchange of information, ideas and opinions.

The Committee believed that while freedom of expression was a "distinctive feature of free societies", it was not an "unimpeded right". It argued that "one person's abuse of his right to freedom of expression" could have a "chilling" effect on others, "leaving them less able to express themselves freely" [18].

The committee found that the internet had given people unprecedented power to express and share their views. It welcomed this and wanted freedom of expression to be strengthened online. However, the committee found that the digital environment was dominated by a small number of private companies with too much control. The committee criticized the freedom of companies to ban anyone and anything they wanted and to design their platforms to encourage and amplify certain types of content over others. The committee argued that social media platforms were not "neutral means" for communication. At the same time, the way they were designed "shapes what users see, what they say and how they interact". The committee suggested that platforms were "too often" driven by "concerns about their commercial and political interests". It stressed that "the benefits of freedom of expression should not be curtailed by these companies".[18]

The committee argued that the government should create a new regulatory approach. In particular, the rights and benefits of individuals should be underpinned by a new, unified regulatory approach that brings together competition policy, data, design, law enforcement, and child protection. In this way, the committee said, the UK has an opportunity to lead the world and set a standard to which other democracies can aspire.

The committee said the harm users can suffer online had received increased attention in recent years and welcomed several proposals put forward in the draft online safety bill to address the issue. These included requiring platforms to remove illegal content and a government focus on protecting children from harm.

However, it disagreed with some other proposals in the bill, such as measures to remove legal content that could be harmful to adults. The Committee argued that there were alternative approaches that would be more effective and better at protecting freedom of expression online. It made recommendations for measures in three areas: content regulation on social media platforms; empowering users; facilitating choice and the like.

The committee found that the largest platforms "monopolized" the market and had "unprecedented control" over what the public could say via Internet with their power to censor views. It acknowledged that moderating views on social media was difficult, particularly because algorithms could not understand context. However, the committee argued that moderation decisions were "often unnecessarily inconsistent and opaque" and sometimes influenced by commercial and political factors.[18]

The committee made several recommendations [18]:

1) Platforms should be required to be impartial in moderating political content. Any definition of content of democratic significance should ensure that contributions to all political debates are covered. Therefore, the definition will not be limited to debates initiated by politicians and political parties about public policy. Protection should include the content of the platform's terms and conditions.

2) Platforms should not be seen as "arbiters of truth". Content should only be removed in exceptional circumstances.

3) Freedom of expression should be a core principle of the duty of care approach. Digital regulatory frameworks should be flexible and able to adapt quickly to change. Frameworks should set "clear expectations" for platforms.

4) Platforms should be required to remove illegal content. Ofcom should set strict time limits within which platforms must remove such content. A platform will not be compliant if it systematically fails to remove illegal content or systematically removes legal content.

5) The government must ensure that all pornographic websites comply with the internet safety regime and meet the highest standards. The committee argued that "an acceptable failure to provide age verification [was] no excuse". It suggested that technological advances in age verification tools "suggest that this was a missed opportunity for the government to make clear on the face of the [Internet Safety] Bill" that websites hosting pornographic content would be blocked for children.

6) Content that is seriously harmful to adults should be defined and criminalized through primary legislation. Content that is legal but may be harmful to adults should be addressed through strict regulation of platform design, digital citizenship education, and competition regulation. The Committee did not support imposing a duty on platforms to remove content that was legal but may be harmful

to adults. It argued that this could lead to "unprecedented interference" with freedom of expression.

7) A general committee of parliament should be established to scrutinize the work of digital regulators, the independence of Ofcom, and the legislative tools for digital regulation.

The committee argued that greater competition was critical to advancing freedom of expression online. It thought that in a more competitive market, platforms would have to be more responsive to users' concerns about freedom of expression and other rights.

The Committee made the following recommendations in this area:

1) The Government should provide statutory powers to the Digital Markets Unit (DMU)[21]. The Commission suggested that this was more important than the Internet Safety Bill because of the "impact of competition on freedom of expression and privacy standards".

2) The DMU should have the power to carry out structural interventions to enhance competition, including working with international partners to block mergers and acquisitions, forcing companies like Google to share click and search data with competitors, and preventing companies from paying to be the default search engine on mobile phones. He also said the DMU should include human rights in its assessment of consumer welfare.

3) Ofcom should be required to take into account and report on competition in the market.

4) The government should introduce a category in its regulatory regime for platforms based overseas and with very few UK users, such as local newspapers and classifieds for people with niche interests. There would be less pressure on these platforms to actively prove their compliance with the new safety regime. It would prevent these smaller platforms from choosing to block access from the UK to avoid the burden of regulations.

5) A mandatory bargaining code should be introduced to ensure fair negotiations between platforms and publishers. The code should include how platforms use publishers' content. The code should include the possibility of independent arbitration.

The government published its response to the report in October 2021.[22] The government said it welcomed the report and was "committed to supporting a free, open, and secure internet" in line with "our democratic values".

In setting out its strategy to improve user safety and protect pluralism online, the government outlined several measures. These included:

1) The Internet Safety Bill, designed to combat illegal content, protect children, and empower users while protecting freedom of expression online.

2) Developing a media literacy strategy and safety by design guidelines [23] that empower users to make safe choices online while supporting companies to create safety on their platforms.

The government published the results of its consultation on a new pro-competition regime for digital markets in May 2022 after the committee published

its report. He confirmed plans to put the DMU on a legislative footing with the primary aim of "promoting competition in digital markets within and outside the UK for the benefit of consumers". The government said it would bring forward legislation to implement the reforms when parliamentary time allowed.

The government also published its digital strategy in June 2022 [24], which set out the government's vision for "building a more inclusive, competitive and innovative digital economy". As part of the strategy, the government published an initial framework for monitoring the performance of digital regulation and sought stakeholder views on how to measure regulatory outcomes. The outcomes it seeks to measure include: promoting competition and innovation; keeping the UK safe online; promoting thriving democratic societies through digital technologies that support democratic interaction and preserve freedom of expression and human rights.

Conclusions. In conclusion, it is worth pointing out that freedom of expression is a fundamental human right that must be upheld in democratic societies. The situation when governments unjustifiably restrict freedom of expression, targeting journalists, protesters, and others who are perceived to disagree with the government's views, must be controlled. Today, there is a trend where even in Western democracies, laws curtail protest activity and threaten freedom of the press and freedom of speech through mandatory metadata retention schemes. Civil societies around the world must be vigilant in protecting freedom of expression. This is necessary to improve people's lives and to build and maintain strong, healthy democratic societies.

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HUMAN RIGHTS AND FREEDOMS IN THE METASPACE OF MODERN SOCIETY: THE INFORMATION DIMENSION

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The foundation of modern society lies in information and communication technologies, which exist in constant interaction with other social relations and cannot function independently. Human rights and freedoms extend to the realm of information relations, directly connected to the democratization of society, which emphasizes the increasing role of information.

Guaranteeing human rights and freedoms in the information sphere, as noted in our previous publications [1-3], is one of the most important principles of forming a legal state and a civil society. These rights are integral to the effective mechanism of governance in a democratic society. They address fundamental interactions between citizens and their government: the ability of citizens to criticize the government, live according to their beliefs, and seek protection from repressive government actions.

Freedom is one of humanity's most significant values and achievements, for which there has been a fierce struggle throughout history. The term "freedom" encompasses a wide range of meanings. For some, freedom means the ability to overthrow a tyrannical ruler; for others, it is the right to choose one's subordination or bear arms. At first glance, freedom appears as a versatile construct, capable of taking any form based on individual perspectives or societal demands.

However, freedom manifests and solidifies in the world in a less visible but distinctly defined form of rights: as a legal order, encompassing responsibilities, permissions, prohibitions, and violations. In a natural state, humans are free beings with inherent freedoms, such as the choice of behavior and decisions regarding their lives, including the choice between life and death. Thus, freedom is inherent to human existence.

According to Georg Hegel, humans are "rational within themselves" and must transcend their limits through self-creation while simultaneously delving deeper into their own essence to achieve rationality both within and for themselves [4, p. 77]. This self-realization gives life meaning; otherwise, the very purpose of freedom is questioned.

Information rights and freedoms are essential for mitigating the destructive impacts of aggressive external narratives and for finding meaning in life amidst

social instability. I. Kovalenko and co-authors rightly emphasize the importance of ensuring real information rights and freedoms to rehabilitate political imagination and develop positive rational pragmatism. Such pragmatism can counter conspiratorial narratives, especially in crises, which often lead to dangerous social consequences [5].

Modern Western scholars of freedom of speech, such as Baruch Spinoza, argue that this issue in Europe resonates with his systematic discussions on freedom of thought and expression. Spinoza described freedom of speech as a natural human right that cannot be surrendered. He argued that freedom of expression could coexist with piety and peace and cannot be abolished without also eliminating these qualities [6, pp. 23–28].

The balance between the right to information, freedom of expression, and the protection of personal data is increasingly significant in a dynamically growing digital society. The rise of the Internet and the new paradigm of integrating freedom of expression and the right to information accentuate this balance [7]. In modern debates about human rights in the information sphere, terms like "freedom of information" are often used interchangeably or in relation to the right to information. For instance, I. Zabary emphasizes that today activities like searching, obtaining, and disseminating information play a crucial role in exercising the right to freedom of expression. These activities also help form new perspectives and approaches.

Freedom to disseminate information is linked to the development of concepts like freedom of speech and freedom of the press in a global information society. Meanwhile, the freedom to seek and obtain information relates to the emergence of the "right to information" as a new concept in international law [8, p. 40].

Researchers I. Stadnik and N. Maksyuta connect "freedom of information" with concepts like "freedom of speech" and "rule of law." They note that freedom of speech involves an individual's ability to consciously and independently express their opinions regarding truth. It also includes collecting, storing, using, and disseminating information in any manner. However, they highlight that freedom of speech is relative, allowing for certain restrictions, which should be determined by a fair legal system that harmonizes individual will with societal legal order [9, p. 46].

D. Ivanchenko analyzes the issue of rights and freedoms in communication from the perspective of state governance. He notes that the rapid evolution of communication often outpaces the regulatory capabilities of government institutions. As an alternative to strict state regulation of mass media activities, Ivanchenko proposes the development of a state communication policy rooted in the principles of freedom of speech and access to information. This approach seeks to optimize the potential of two interconnected systems: the state and media institutions [10, p. 42].

I. Kolomiiets underscores that the right to freedom of thought and expression, as well as the free articulation of one's views and beliefs, is a cornerstone of democratic society. However, the exercise of these rights, particularly in disseminating information, entails special obligations and responsibilities. This is especially relevant during wartime, such as under martial law imposed due to large-

scale Russian aggression in Ukraine. In such circumstances, there is a need to reassess the legal grounds for partially restricting constitutionally guaranteed rights and freedoms as outlined in national and international legislation [11].

Some contemporary researchers, like B. Leiter and H. Parens, advocate for reinterpreting "freedom of speech" as "freedom of action," framing its regulation in terms of minimizing harm to core societal values [12–13].

The issue of human rights, particularly information rights, and their practical application during martial law has been the focus of many Ukrainian scholars in civil procedural and judicial relations (e.g., the works of K. Husarov, O. Popov, and others) [14–15]. K. Husarov points out that "the militarization of the aggressor country aimed at dominating the political regimes of other states forces legislative adaptations to martial law conditions in various branches of law" [14, p. 1138]. In such contexts, information rights and freedoms gain exceptional importance and status.

Summarizing various viewpoints on the issue of information rights and freedoms, O. Tyhomyrov asserts that "information rights must be considered from multiple perspectives, reflecting the variability of human rights interpretations, such as fundamental needs, interests, social benefits, and essential conditions for human existence. This creates a basis for a philosophical distinction of their nature."

He notes that the classification of information rights depends on the plurality of human rights interpretations and the diversity of information rights as a unique formation within the systems of human rights, social values, legal mechanisms, and cultural achievements. Information rights, like human rights in general, can be examined as categories of both individual and fundamental freedoms. However, many legal scholars regard the distinction of these categories as somewhat conditional or relative [16, p. 48].

These perspectives call for a clearer understanding of the essence of information freedom, freedom of speech, and the right to information, as well as the correlation between these concepts in modern society.

Humans cannot exist outside of society, but each individual possesses a certain degree of freedom. It is essential to find a universal measure of civil liberty where personal freedom can be realized. This universal freedom, reflecting the collective interests of society, is shaped by necessity and reinforced by norms, rules, and laws. As Cicero once emphasized, a person must be a servant to laws to be free; there are no alternatives, as one cannot exist outside society without an awareness of their own freedom, which is inherently absolute.

Freedom, and its various forms of realization, has been a relevant topic since the dawn of humanity. However, freedom itself is impossible without information, as information forms the foundation for choice, and the ability to choose is the essence of freedom.

The intrinsic connection between information, freedom, justice, and law has long been recognized. As early as the 8th century BCE, norms regulating informational activities existed. Over time, with the evolution of societal relations and technological progress, the sphere of informational activity has developed significantly. This led to the emergence of a cluster of informational rights, mass

media, and regulated informational processes within state-governed societal relations. The advent of the information society, driven by technological advances, gave rise to a new legal field – information law – and established a distinct type of human freedom: informational freedom [17].

The presence of freedom in the world is one of the essential attributes of human existence. Freedom, as a fundamental concept, can be broken down into several components: absolute freedom, human freedom, and its subcategories, such as informational freedom, creative freedom, freedom of thought, and others. Notably, Montesquieu distinguished the following types of freedom: "Philosophical freedom lies in the unhindered manifestation of our will, or, at the very least (according to the general interpretation of all philosophical systems), in our belief that we exercise it without obstruction. Political freedom lies in our security or, at the very least, in our confidence that we are safe" [18, p. 122].

In the process of exercising freedom, a person makes a choice, selecting between possible actions, and bases this choice on previously acquired information. The necessity of choosing between absolute demands is an inescapable characteristic of the human condition. The content of the choice consists of numerous and varied desires that conflict with one another, forcing the individual to decide which desire is most appropriate to pursue and fulfill at the present moment. Every choice involves the freedom to act—that is, the ability to do what we choose. However, even where there is the right to choose and freedom to act, alongside the sense of freedom, there arises a feeling of unfreedom. This occurs because the person making the choice seeks not only to fulfill desires and satisfy conflicting needs, but also feels that the impossibility of achieving all of them simultaneously is subjectively experienced as a violation of their freedom. Free choice always has certain limits, and while a person may freely make decisions, they are still to some extent constrained. The knowledge of the available options plays an important role in making the choice.

Informational freedom has a number of characteristic features [1, 2, 19-21]. First, one of the indispensable functions of informational freedom is the development of human self-awareness as a key component of their freedom. A person becomes aware of and directs their activities, perceiving themselves as the source of these activities, influencing and opposing the object. This conscious opposition makes a person a subject with their own unique and individual "Self." Through processes of interaction and communication, a person acquires and develops self-awareness, using it to understand the norms of society, manage their behavior, and assess themselves and the individuals they interact with.

Secondly, an essential characteristic of informational freedom is the availability of multiple sources of information. This means that, in order to exercise informational freedom, a person must have access to several producers and distributors of information from whom they can obtain diverse information. By synthesizing this information, they can make a choice to pursue certain actions, thereby realizing their freedom.

Thirdly, the ability of a person to transmit information further characterizes informational freedom. A person must have the ability to convey information to any subject. At the same time, when transmitting and receiving information, one must recognize that both information sources and information recipients possess their own freedoms, and a person should not infringe upon these freedoms.

Fourthly, the specificity of informational freedom lies in the fact that a significant portion of social relations can be reflected in legal norms. Regulating information processes between individuals and the state, as well as between individuals and public organizations, is entirely possible. However, it is much more difficult to control informational processes in everyday communication, such as when exchanging information about family matters or during friendly meetings. The law can establish general principles for the actions of individuals, but it is impossible to apply these principles in every situation. In this context, each person must base their actions on the general principles of law, freedom, morality, and customs. The state finds it difficult to intervene in this sphere of life, as any judgments made by state authorities based on vague legal formulations may violate an individual's freedom.

Fifthly, informational freedom must find its expression in informational rights. However, no less important is the fact that informational freedom should also be expressed in the morality and customs that prevail in society. In this case, morality serves as a regulator of human behavior, a regulator that requires the presence of public authority. Morality serves as a criterion for the value-based vision of the world and is a means of harmonizing society's attitude toward the individual. As one aspect of how people perceive their social relations, morality pertains both to consciousness and to reality.

The particular significance of informational freedom lies in its organic connection with natural law. Informational freedom provides individuals with a range of opportunities dictated by the natural state of human existence—a state of freedom. These opportunities, which are contingent on the will of the state, are derived not from the state itself but from the very nature of humanity. The state cannot grant the ability to realize informational freedom, nor can it revoke it. Instead, the state is obligated to create, through legal norms, the conditions that enable individuals to exercise their rightful informational freedom.

A pivotal role within informational freedom is played by human informational rights, which in turn are part of the broader concept of law.

By establishing the interdependence of appropriate and possible behavior, the unity and equality of mutual rights and obligations, the law emerges as the positive existence of freedom. It eliminates self-governance, arbitrariness, and the suppression of individuality, delineating the boundaries of freedom [22].

Law serves as a mechanism that, through specific legal methods, enables the realization of an individual's informational freedom. As both a product and a result of the natural development of society as a whole, law must take into account the interests of both society and the individual. Law provides individuals with a range of opportunities that they can utilize to exercise their inherent informational freedom.

Informational rights cannot be categorized into a specific group, as they are utilized by individuals across all areas of life and at various stages. This underscores the importance of informational rights and their significant role in every person's life.

In addition to rights that directly implement informational freedom, there exist "adjacent rights," which represent a broader group of rights supporting the realization of a wide range of rights and freedoms, including human informational freedom and informational rights. These include the right to petition, the right to appeal to government authorities, the freedom of mass media, the right to obtain information about environmental conditions, and more. Informational rights do not duplicate these but correlate with them as a general to a specific category. In other words, informational rights regulate informational processes in areas not governed by other rights that deal with information. Informational rights, being an organic part of the structure of other rights and freedoms, organize informational processes. Since informational freedom implies a set of opportunities arising from natural law and informational rights, it is precisely from the perspective of informational freedom that human informational rights should be studied and interpreted. Discussions about informational freedom in modern society should be approached through this lens.

The realization of informational freedom in society is one of its most important objectives. In exercising this freedom, a person receives information about various objects in the material and ideal worlds, exchanges information with different entities, and generates new information. The acquisition and transmission of information occur through interactions with information carriers, which may hold data on a single object or aggregate information about multiple objects and transform it.

The limitations on an individual's informational freedom are stipulated at the international level in the Universal Declaration of Human Rights. Article 29 states [23]:

1. Everyone has duties to the community in which alone the free and full development of their personality is possible.

2. In the exercise of their rights and freedoms, everyone shall be subject only to such limitations as are determined by law solely for the purpose of securing due recognition and respect for the rights and freedoms of others and of meeting the just requirements of morality, public order, and the general welfare in a democratic society.

3. These rights and freedoms may in no case be exercised contrary to the purposes and principles of the United Nations.

Thus, an individual's informational freedom exists within certain boundaries. Beyond these boundaries, their actions may begin to infringe on the rights and freedoms of others. The most challenging issue facing society is determining the precise limits within which individuals may exercise their freedom.

Restrictions on informational freedom are also established in the International Covenant on Civil and Political Rights (Article 19): "Everyone shall have the right to hold opinions without interference. Everyone shall have the right to freedom of expression; this right shall include freedom to seek, receive, and impart information and ideas of all kinds, regardless of frontiers, either orally, in

writing, or in print, in the form of art, or through any other media of their choice" [24]. The same article emphasizes that the exercise of these rights "carries with it special duties and responsibilities. It may therefore be subject to certain restrictions, but these shall only be such as are provided by law and are necessary: (a) for respect of the rights or reputations of others; (b) for the protection of national security, public order, public health, or morals" [24].

The European Convention on Human Rights and Fundamental Freedoms likewise provides for limitations on an individual's informational freedom (Article 10): "Everyone has the right to freedom of expression. This right shall include freedom to hold opinions and to receive and impart information and ideas without interference by public authority and regardless of frontiers. The exercise of these freedoms, since it carries with it duties and responsibilities, may be subject to such formalities, conditions, restrictions, or penalties as are prescribed by law and are necessary in a democratic society, in the interests of national security, territorial integrity, or public safety, for the prevention of disorder or crime, for the protection of health or morals, for the protection of the reputation or rights of others, for preventing the disclosure of information received in confidence, or for maintaining the authority and impartiality of the judiciary" [25].

In many countries, particularly those with a totalitarian past, the focus of protecting informational freedom shifts from relying on the state to defending against it. In these contexts, oversight of state activity must be conducted through supranational bodies that are independent of the state's will, its economy, or its political climate.

As the conceptual foundation of the right to information is currently in a phase of active development and formation, no universally recognized approaches to defining its essence have been established. However, as noted in our previous publications, significant attention is given to the relationship between the right to information and other informational rights and freedoms of citizens [26–28]. This relationship greatly influences the choice of terminology used to define this concept. Therefore, it is worth examining the connection between the right to information and related concepts to appropriately understand this phenomenon.

Of particular interest is the relationship between the right to information and freedom of speech, the latter being a precursor to the former. Historically, the right to information "emerged" from freedom of speech. Furthermore, in many countries, constitutional norms regarding freedom of speech have gradually incorporated the relatively new concept of the right to information, even though it was not part of the original constitutional framework. It is generally understood that the legal regulation of informational rights and freedoms varies across different countries, each with its own distinct characteristics. On this basis, a common perspective is that freedom of speech encompasses the right to information. However, the inclusion of the right to information within the framework of freedom of speech and the press has faced significant objections, as it narrows the scope of the former. Access to information is merely one aspect of the more limited right to information, while

declarations about information tend to absorb freedom of speech and the press, focusing primarily on the dissemination of information.

In our view, the right to information is not subsumed by freedom of speech, nor is it one of its elements; in fact, it stands in certain opposition to it. The right to information primarily entails the right to objective information about what is happening in life, whereas freedom of speech is directed at the free circulation of evaluative information, opinions, and positions of individual subjects.

Another important criterion distinguishing the right to information from freedom of speech is effective access to sources of information. Access to sources is not critical for the exercise of freedom of speech or the exchange of opinions on societal matters, whereas the absence of access to significant information gravely undermines the right to information for any member of society. Additionally, the right to information and freedom of speech perform different functions in society. While freedom of speech ensures the free discussion of public affairs, the right to information enables civil society to interact with the state, incorporate new information into ongoing public debates, and hold government authorities accountable.

The human right to information secures the most fundamental social opportunities in managing information. Its essence is primarily revealed in connection with freedom, which is a universal attribute of human rights, serving as both the measure and content of freedom. Freedom is the essence of rights. In human rights, freedom finds its dimension and meaning. Accordingly, an effective mechanism for realizing the right to information directly ensures the informational freedom of citizens. In principle, human rights and freedoms are understood as limitations on state power, with the extent of freedom determined by the degree of individual autonomy. The boundaries of freedom are significantly broader than the boundaries of human rights.

The entire system of citizens' informational rights and freedoms is encompassed in the concept of "freedom of information," which includes freedom of speech and expression, freedom of the press and mass media, as well as the rights to search for, receive, produce, store, disseminate, and transmit information. It may also include the right of citizens to issue public responses and refute false information, protect sources of information, prevent censorship, and exercise other rights in the informational sphere.

As a legal institution, freedom of information represents a set of legal norms that regulate social relations, guaranteeing individuals the opportunity to apply their abilities in various areas of life through participation in informational processes and fulfilling their material and spiritual needs. Freedom implies the selective activity of the individual, their purposeful actions under objective political, economic, and legal conditions. Freedom of information facilitates human self-realization, the full development of talents and abilities, and the satisfaction of needs. Distinctive features of freedom of information include free management of information and noninterference in the realm of individual informational activity, which exists beyond obligations to society and the state. State intervention in the spiritual life of an individual must be limited, as this sphere encompasses

manifestations of reason, emotion, and will. Therefore, reliable guarantees of protection from state authorities and officials who hinder citizens' exercise of their informational freedom are crucial. It is worth reiterating that freedom of speech and freedom of information, as fundamental rights, protect individuals from arbitrary state interference in the most vital aspects of their lives [1, 29-30].

Critically evaluating the research findings presented above, it is important to emphasize that the digital age has become increasingly dependent on cyberspace, a dependence that impacts human freedom in general and informational freedom in particular. The freedom of choice is especially constrained by the information available to us, as decisions are based on this existing information.

With the growth of the Internet and electronic commerce in an era of total digitalization and cloud computing, the commercialization of personal information has become inevitable. Therefore, the protection of the traditional right to privacy and personal data has become particularly pressing in modern conditions.

It is essential to underscore that human informational freedom is not absolute. Each state and the value system accepted within its society provide specific methods for limiting informational freedom.

On the other hand, it is impossible to definitively determine the potential extent of freedom. Factors such as international and national law, national mentality, cultural level, upbringing, and education all influence its permissible degree.

Thus, due to the breadth and ambiguity of the concept of information itself, the essence of the term "human freedom" and the concept of informational freedom appear extraordinarily comprehensive. Indeed, defining the boundaries of these freedoms is challenging. They pertain to the informational dimension of societal life as a whole and guarantee the informational autonomy and self-determination of the individual.

Despite the lack of clear boundaries for freedom of information, its content is quite specific and is expressed through a set of specific rights and historically traditional personal freedoms. Chief among these are the traditional freedoms of speech and expression, as well as the right to information, which is still in a developmental stage. An analysis of the relationship between freedom of information, freedom of speech, and the right to information suggests that the right to information and freedom of speech are two distinct elements of the broader concept of freedom of information. This assertion is based on the nature of information, which encompasses not only evaluative statements, opinions, or positions but also factual and objective data.

Freedom of information does not exhaust its scope within freedom of speech or the right to information. It also includes other informational rights of citizens in society, particularly the freedom of mass information, which is concrete in its content and pertains to the functioning of mass media. This freedom broadly applies to the entire realm of communication and information circulation within society.

Freedom of information is an essential guarantee of the informational security of individuals, society, and the state. Thus, ensuring it at the legislative level

is of particular importance for every entity responsible for security, especially during the formation and development of an information society.

Freedom of information is not confined to a specific type of social information. It can be assumed that the boundaries of informational freedom will continue to expand with the development of the information society and the emergence of an information civilization. The limits of informational freedom are defined by the boundaries of specific rights and freedoms regulated by legislation, which constitute the essence of freedom of information.

The relationship between the right to information and the right of access to information warrants special attention. The former is often persistently substituted by the latter. It should be noted, however, that the right of access to information is a component of the broader constitutional right to information. Beyond the rights to seek and receive information, the right to information also includes the rights to transmit, produce, and disseminate information.

Essentially, the right of access ensures the implementation of the broader right to information. However, both rights serve the same social functions and are often used interchangeably in terminology. This substitution is justified, as the criteria distinguishing these concepts are largely formal and do not signify substantial differences. It may be appropriate to consider the relationship between these concepts as general and specific. The right of access to information, by providing the opportunity to review official documents, ensures the realization of the broader right to information.

Thus, human informational freedom, along with the set of legal norms regulating it, requires comprehensive philosophical study and reflection. Given its exceptional importance and relevance, the interrelation and interplay of informational rights and freedoms should be viewed as a promising area for further research. This research can span various fields, including law, sociology, and the theory of state and law, as well as broader philosophical generalizations. Furthermore, this issue must also find practical application: in legislative activities at the state level, in the operations of local government bodies, and in the drafting of documents at intergovernmental (international) levels.

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APPLICATION OF DIGITAL TWIN TECHNOLOGY IN POST-WAR CITY RECONSTRUCTION: NEW HORIZONS FOR RECOVERY

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Abstract:

Digital Twins represent an innovative technology that is increasingly being adopted in urban planning, management, and infrastructure recovery. This article discusses the development of a digital twin for Mariupol (Ukraine), a city severely affected by military actions and currently under occupation. The digital twin will be developed based on data collected before the occupation, with the goal of facilitating the efficient reconstruction of the city after its liberation. The primary objective of implementing digital twin is to create tools for the rapid restoration of the city and provide convenient simulation of urban planning scenarios. The article also discusses the development algorithms and mathematical models that can be used to build and manage such systems.

Introduction:

Mariupol, a key city in southeastern Ukraine, has suffered significant damage due to military actions and occupation. Its reconstruction after liberation will be one of the most critical tasks for the Ukrainian government, international organizations, and local authorities. To effectively and quickly restore the city's infrastructure, innovative approaches are required, one of which is the use of Digital Twin technology (fig.1).

A city's digital twin is a virtual model that integrates data about urban infrastructure, buildings, transportation, and other city components in real-time[1]. Through the use of digital twin, it is possible to analyze and simulate various reconstruction scenarios, significantly accelerating the planning and decision-making processes.

The main goal of creating a digital twin for Mariupol is to enable the rapid restoration of urban infrastructure after liberation (fig.2). An important feature of digital twin is its ability to simulate various development and urban planning scenarios and provide analytical data for selecting the best solutions in each case [2].

Fig. 1. *Interactive map of the destruction city Mariupol [2]*

The digital twin of Mariupol will allow:

1. Rapid restoration of critical infrastructure, such as roads, bridges, and utility networks.
2. Simulation of different urban development scenarios for optimal land use and resource allocation.
3. Optimization of transport flows and urban transport systems.
4. Development of energy efficiency plans and sustainable urban development.
5. Provision of data for rapid responses to emergencies, such as natural disasters.

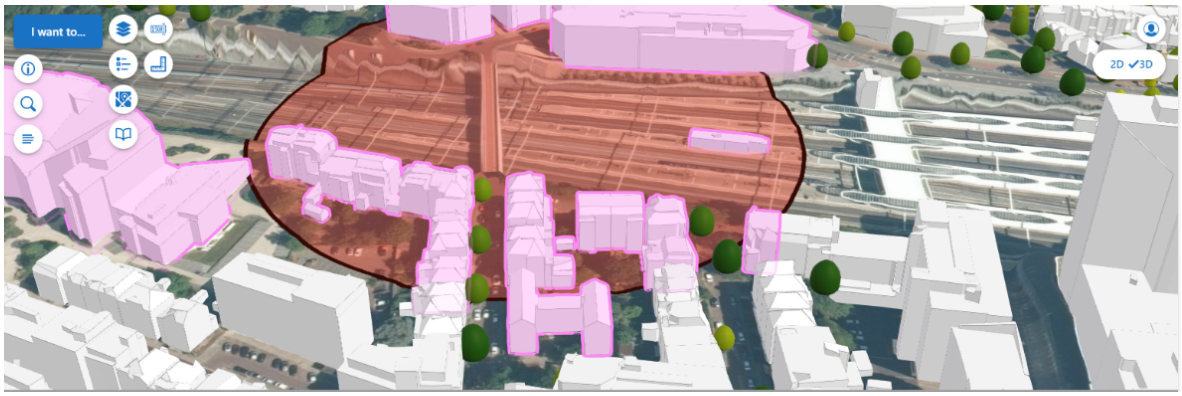

Fig. 2. *Opportunities for creating a digital twin with subsequent scenario simulation for the Mariupol railway station area*

The creation of a digital twin for a large, war-affected city like Mariupol requires a comprehensive development algorithm that includes several key stages (fig.3).

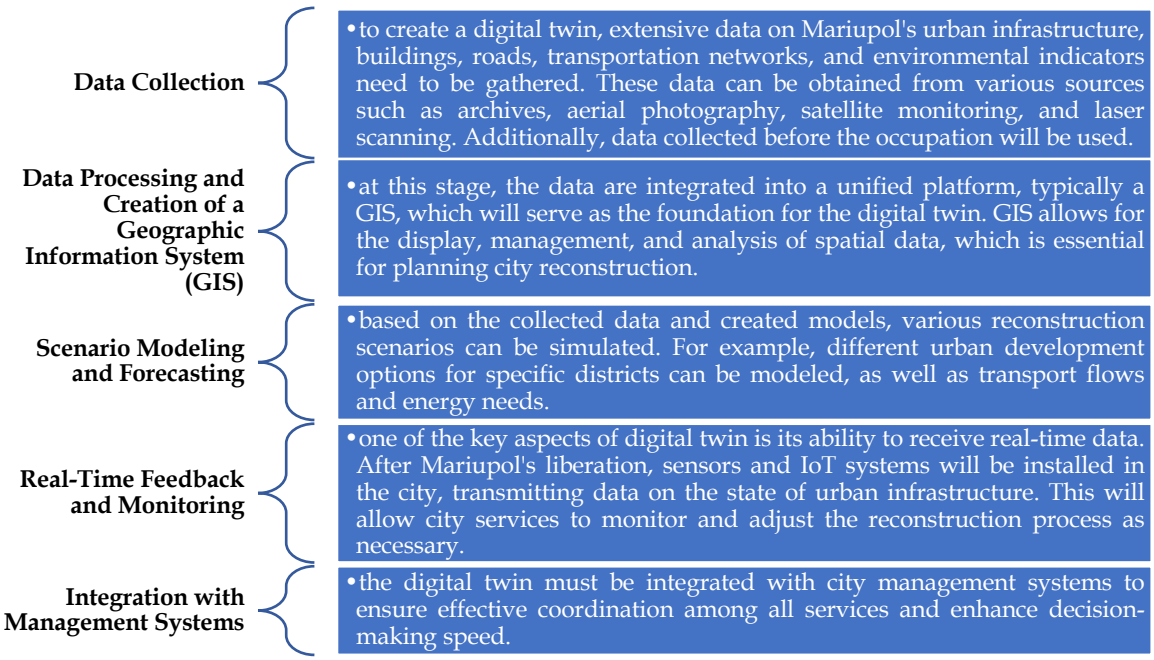

Fig. 3. *Development algorithm a digital twin for Mariupol*

Several types of mathematical models are used to build a city's digital twin, each serving a specific function within the digital twin system. Here are the main models that can be applied to the reconstruction of Mariupol:

a) Geometric Models: these models form the basis of any digital twin and represent the buildings and infrastructure. They are created using data from laser scanning, aerial photography, and satellite images. For Mariupol, these models will be essential for restoring accurate city planning blueprints;

b) Physical Models: physical models account for factors such as building loads, weather conditions, and other environmental impacts on infrastructure. These models are crucial to ensuring the resilience of structures in Mariupol during reconstruction;

c) Scenario Models: scenario models allow the simulation of various reconstruction and development scenarios. These models will be used to analyse multiple urban development options and select the best outcome based on criteria such as energy efficiency, accessibility, and traffic flows;

d) Transport Models: transport models forecast vehicle movements, pedestrian flows, and road load. In Mariupol, these models will help optimize transport flows and minimize congestion;

e) Economic Models: a vital component of the digital twin is economic modelling, which assesses the cost-efficiency of reconstruction efforts. These models are used to forecast recovery costs, evaluate project profitability, and plan resource allocation.

Advantages of using Digital Twins in reconstruction: using a digital twin for the reconstruction of Mariupol will offer numerous advantages. First, it enables the simulation of various urban development scenarios without real-life experimentation,

saving time and resources. Second, it will optimize planning and construction processes, ensuring the city's sustainable development. Additionally, Digital Twins will help minimize risks and simplify urban environment management.

Conclusions:

The creation of a digital twin for Mariupol after its liberation will be a key step in its reconstruction process. Digital Twins technology offers unique opportunities for modelling and optimizing urban processes, which is particularly important in the context of rapid recovery following military actions. The use of digital twins will not only speed up the city's restoration but will also make Mariupol an example of a sustainable and modern city ready to face future challenges.

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LAW IN THE CONTEXT OF SOCIAL AND DIGITAL TRANSFORMATION

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As scientists note, the modern change in the managerial, economic and social landscape is largely due to digital technologies that transform the way of life of people and the algorithms of functioning of enterprises and public authorities. Given the accelerated impact of information technologies on society, the interpenetration of various spheres and directions, the boundaries of the action of public administration on subordinate objects are becoming unclear. Future transformations involve the construction of new technologies and management models based on a full replacement of the existing paradigm, which was largely formed in the "pre-digital" era. Digital transformation is organizational or social changes based on the introduction of digital technologies into all aspects of human interaction. Transformational changes are manifested in the emergence of innovative methods of work in the process of using technologies, which replaces the simple expansion or support of traditional approaches. Further development of digital transformation is seen in building a smart society, in which the "digital state" will be able to anticipate and satisfy the complex and individually differentiated needs of a particular person based on his personal characteristics and interests, forming an integral array of high-quality services in various areas of activity. Of course, a smart society should be formed on the basis of timely implementation of innovations; a modernized education system; the functioning of new paradigms of public administration that interact with most social and business processes; the ability of citizens to directly influence the main processes of digital transformation and control these actions [1].

Digital transformation significantly affects the quality of life of ordinary citizens, the efficiency of business entities based on automation, mechanization and robotization. Digital transformation affects all areas of activity. Society, the state and business entities are consumers of innovative information technologies. In the context of globalization, digital transformation is the main factor in increasing the competitiveness of world economies, creating services and products of higher quality and value, etc. Therefore, studying the advantages and disadvantages of digitalization of the economy is a necessary condition for the spread of innovative information technologies in all industries and areas of activity [2].

In the current conditions of social and digital transformation, it is quite logical that law is developing accordingly. It is not static, it is constantly in dynamics, receiving in the process of development of society an appropriate impetus for its

further development, especially regarding the regulation of social relations in the process of digital transformation of society. Thus, both strategies and doctrines are designed to determine the basic principles and principles on which legislative and all other regulatory legal acts of government bodies should be based in order to legally regulate emerging and functioning social relations related to digital transformation. Human rights are undergoing special changes in the conditions of digital transformation.

Particularly indicative in this context is the rapid development of electronic democracy; the introduction of electronic document management; access to the Internet; the development of telecommunications; the introduction of national electronic information resources; the provision of electronic services in all spheres of public life; the implementation of electronic identification; the digitalization of administrative services, etc. As scientists note, the process of transformation of human rights has significantly accelerated in the context of technological globalization and leads to the emergence of the fifth generation of human rights, which are characterized by artificial intelligence and the digital transformation of society [3, p. 5].

As scientists note, the practice of developing law in the modern world gradually introduces the category of "digital rights" (also known as Internet rights, network rights) into the conceptual and legal circulation, which has become widespread as an important element for characterizing the legal status of a person on the Internet. At the same time, such a category of rights as "digital rights" has not yet received general recognition either in law or in doctrine, including in view of domestic legal and law enforcement experience. Obviously, this is due to the fact that the problem of searching for and determining the specifics of fundamental human rights (their content and implementation) in the digital environment arose relatively recently and, perhaps, the solution to this issue is a matter of the near future [4, p. 19].

It is difficult to agree with this position, since the so-called "digital rights" are actually human rights in the information sphere, and digitalization is actually the saturation of society with various devices, means, systems using electronic and digital technology and the establishment of electronic communication exchange between them. Before the advent of digital technologies, society went through mechanical, tube, semiconductor, microcircuit, chip technologies, and at the same time there was no question of introducing the types of rights associated with these terms (mechanical, tube, semiconductor, microcircuit, chip rights). That is, it is not advisable to "invent" human rights for each technology, since society has adopted an appropriate approach to defining rights in large spheres of life (political, economic, social, natural), which, in turn, are divided into smaller ones, according to the sphere of human activity - in medical, environmental, cultural, trade, etc. spheres.

In view of the above, the so-called "digital rights" of a person that arise on the Internet (thereby being human rights in the information sphere) are correlated with other fundamental human rights specified in the Charter of Fundamental Rights of the European Union [5], which enshrines the main political, social and

economic rights of citizens of the European Union. This corresponds to the provisions of Part One of Article 8 of the Constitution of Ukraine, according to which the principle of the rule of law is recognized and operates in Ukraine. The rule of law is the rule of law in society [6].

The rule of law stands in sharp contrast to the idea that a ruler, a legislator, can be above the law, which was a feature of Roman law, Soviet law, Nazi law, and some other legal systems. Today, it is a fundamental principle of law, meaning that no person is above the law, that no one can be punished by the state except for a violation of the law, and that no one can be held accountable for a crime other than in accordance with the procedure established by the law.

At the same time, it should be noted that this term is now proposed to be replaced by the term "pravoladdya", which was introduced by Doctor of Law, member of the Venice Commission from Ukraine S. Holovaty in his fundamental study "The Rule of Law: Monograph: In 3 volumes" (2006) as a counterpart to the English concept "the rule of law", proposed by him at one time [7].

The reasons for the transition from the two-word "rule of law" to the one-word "rule of law" as the equivalent of the English "the rule of Law" were several factors:

1. After the adoption of the Constitution of Ukraine, domestic scientists resorted to explaining the essence of the concept of "rule of law" by means of an "element-by-element analysis" of the content of each of the components of the two-word expression, and not by clarifying the essence of the concept as a whole, that is, indecomposable. An example of such an approach was the proposal to "establish, first, what phenomenon is reflected by the concept of "law", and, secondly, what the supremacy of this phenomenon consists of.

2. The expression "Rule of law" is lexically close to one of the basic elements of the positivist doctrine of law in the form of the concept of "rule of law", which, in turn, led to the identification of both concepts. As an example, the thesis that "the principle of the rule of law has the expression of the rule of law".

3. Another common direction of interpretation of the essence of the concept of "rule of law" in domestic science was the approach in which it was recognized either as a "necessary feature", or as a "fundamental principle", or as a "part of the characteristics" of another concept – "rule of law". Here there was a crossing of two completely independent legal concepts, while "rule of law" and "rule of law" have never historically been and are not materially structurally interconnected [8].

There is consensus on the core elements of the concept of "the rule of law". These core elements are:

1. Legality – including a transparent, accountable and democratic procedure for the implementation of legal provisions.

2. Legal certainty.

3. Prohibition of arbitrariness.

4. Access to justice in independent and impartial courts – including judicial review of administrative acts.

5. Respect for human rights.

6. Non-discrimination and equality before the law [8].

At the same time, a number of well-known Ukrainian scientists (P. Rabinovych, O. Lutsiv) believe that the translation of the English expression "the rule of law" into Ukrainian proposed by S. Holovaty using the one-word term "rule of law" is not accurate and does not solve the problem of a universal understanding of the principle of the rule of law. After all, even in this case, without clarifying the content of the concept of law, it still remains unclear which phenomenon should "rule" (and, moreover, over whom/what...) [9].

Retired judge of the Constitutional Court of Ukraine Mykola Kozyubra also initially believed that the new term introduces confusion when applying concepts in science and practice. However, recently the scientist changed his view and agreed that in Ukrainian "rule of law" can be a substitute for the phrase "supremacy of law".

On June 27, 2016, the National Presentation of the document "Rule of Law Checklist" was held in Kyiv with the participation of the President of the Venice Commission Gianni Buquicchio, translated into Ukrainian as "The Rule of Law Checklist". The document of the Venice Commission "Report on the Rule of Law" (CDL-AD (2011) 003rev) translated into Ukrainian is presented as "Report on the Rule of Law" [8]. Thus, the factors for the transition to the term "rule of law", corresponding to the English "the rule of Law", are the following factors:

1. After the adoption of the Constitution of Ukraine, domestic scientists resorted to explaining the essence of the concept of "rule of law" by means of an "element-by-element analysis" of the content of each of the components of a two-word expression, and not by clarifying the essence of the concept as a whole, that is, indecomposable. An example of such an approach was the proposal to "establish, first, what phenomenon is reflected by the concept of "law", and, secondly, what the rule of this phenomenon consists of" [10].

2. The expression "Rule of law" is lexically close to one of the basic elements of the positivist doctrine of law in the form of the concept of "rule of law", which, in turn, led to the identification of both concepts. As an example, the thesis that "the principle of the rule of law has the expression of the rule of law".

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Thus, the established expression "Supremacy of Law" should be translated into English as "Supremacy of Right", which means that Human Rights (including Constitutional Rights) have the highest priority over any Law or by-law. Therefore, Human Rights cannot be narrowed or abolished. It is this important meaning that is embedded in the Constitution of Ukraine [11].

Thus, the idea of the rule of law as the foundation of modern states and civilizations has recently become an even more powerful talisman than the idea of democracy. The former Lord Chief Justice and one of the most insightful legal experts in this world, Tom Bingham, has investigated that this idea means the foundation of a beautiful and just society, a guarantee of responsible government, a means of ensuring peace and cooperation [12].

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SEAM-MODEL AS A PLATFORM FOR INNOVATIVE DIGITAL LEARNING AND CONTINUOUS PROFESSIONAL DEVELOPMENT OF FUTURE MANAGERS IN SOCIETY 5.0

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Abstract. The integration of digital technologies into education and business has the potential to revolutionize the way we learn and work. The SEAM (Socio-Economic Approach to Management)-Model, a framework for innovative digital learning, offers a promising approach to enhance the professional development of future managers. By leveraging digital tools and techniques, this model can foster creativity, critical thinking, and problem-solving skills, equipping future leaders with the necessary competencies to navigate the complexities of the 21st century. This section of the monograph explores the potential of the SEAM-Model to address the evolving needs of modern organizations and contribute to the overall development of society 5.0.

Keywords: SEAM-model, digital learning, professional development, future managers, innovation, technology, education.

The rapidly evolving landscape of business and technology demands a new generation of leaders equipped with a unique blend of hard and soft skills. While technical expertise remains crucial, the ability to effectively communicate, collaborate, innovate, and adapt to change has become increasingly essential. The SEAM-model, a comprehensive framework for education and development, offers a valuable approach to cultivating these soft skills in future managers.

By integrating social, emotional, and cognitive dimensions, the SEAM-model provides a holistic approach to learning and development. It empowers individuals to develop essential soft skills such as:

- emotional intelligence as the ability to understand and manage one's own emotions, as well as the emotions of others;
- critical thinking as the ability to analyze information, evaluate evidence, and make informed decisions;
- creativity as the ability to generate new ideas, think outside the box, and solve problems in innovative ways.

These soft skills are crucial for success in the modern workplace. They enable individuals to adapt to change, build strong relationships, and drive innovation. By focusing on the development of these skills, the SEAM-model can help prepare future managers for the challenges and opportunities of the 21st century.

Author explored (tables 1-3) how the SEAM-model can be applied to develop these soft skills in various professional contexts and systematized the importance of integrating digital technologies into the learning process and how this can enhance the development of soft skills as hard\professional competences.

Table 1. *Developing Emotional Intelligence within the SEAM-Model*

SEAM-Model Component	Soft Skill	Practical Tasks	Expected Outcome
Social Skills	Empathy, self-awareness	Role-playing exercises, self-reflection, feedback	Increased self-awareness, ability to understand others' emotions
Critical Thinking	Self-assessment, stress management	Emotional journaling, mindfulness techniques	Improved self-esteem, ability to manage stress effectively
Creativity	Emotional integration, openness to new experiences	Artistic activities, brainstorming	Increased emotional flexibility, ability to adapt to change

Source. Analyzed and systematized by the author based on [1] - [3]

Table 1 highlights the pivotal role of emotional intelligence in shaping effective future managers. By focusing on the SEAM-model's components of social awareness, self-regulation, and relationship management, individuals can develop a profound understanding of their own emotions and the emotions of others. This emotional intelligence, when cultivated, transcends the realm of a soft skill and becomes a foundational professional competency.

For future managers, emotional intelligence is not merely a personal advantage but a strategic asset. It equips them to build strong relationships, resolve conflicts effectively, and inspire their teams. By understanding the nuances of emotional expression and response, managers can create a positive and productive work environment.

The SEAM-model serves as a foundation for analyzing the dynamics of emotional intelligence development, as depicted in Figure 1. This model allows us to monitor changes in each component of emotional intelligence and evaluate their overall impact on personal effectiveness. By integrating SEAM-principles, the analysis becomes more focused on practical outcomes, aligning individual growth with professional competencies critical for future leaders.

Figure 1 illustrates the dynamics of emotional intelligence development from 2022 to 2027. The creation of this graph was necessary to visualize and analyze the trends in various components of emotional intelligence over time. By plotting the scores for self-awareness, self-regulation, empathy, and social skills, the graph provides a clear overview of how these competencies have evolved.

The graph reveals a consistent upward trend in all four components of emotional intelligence over the six-year period. Self-awareness consistently demonstrates the highest scores, indicating a growing understanding of one's emotions and how they influence behavior. Self-regulation and empathy also show significant improvement, suggesting that individuals are becoming better at managing their emotions and understanding the perspectives of others. Social skills, while exhibiting a positive trend, seem to have a slightly slower rate of growth compared to the other components. This aligns with the SEAM-model's insights,

emphasizing the need for targeted strategies to enhance interpersonal skills as part of a holistic approach to emotional intelligence development.

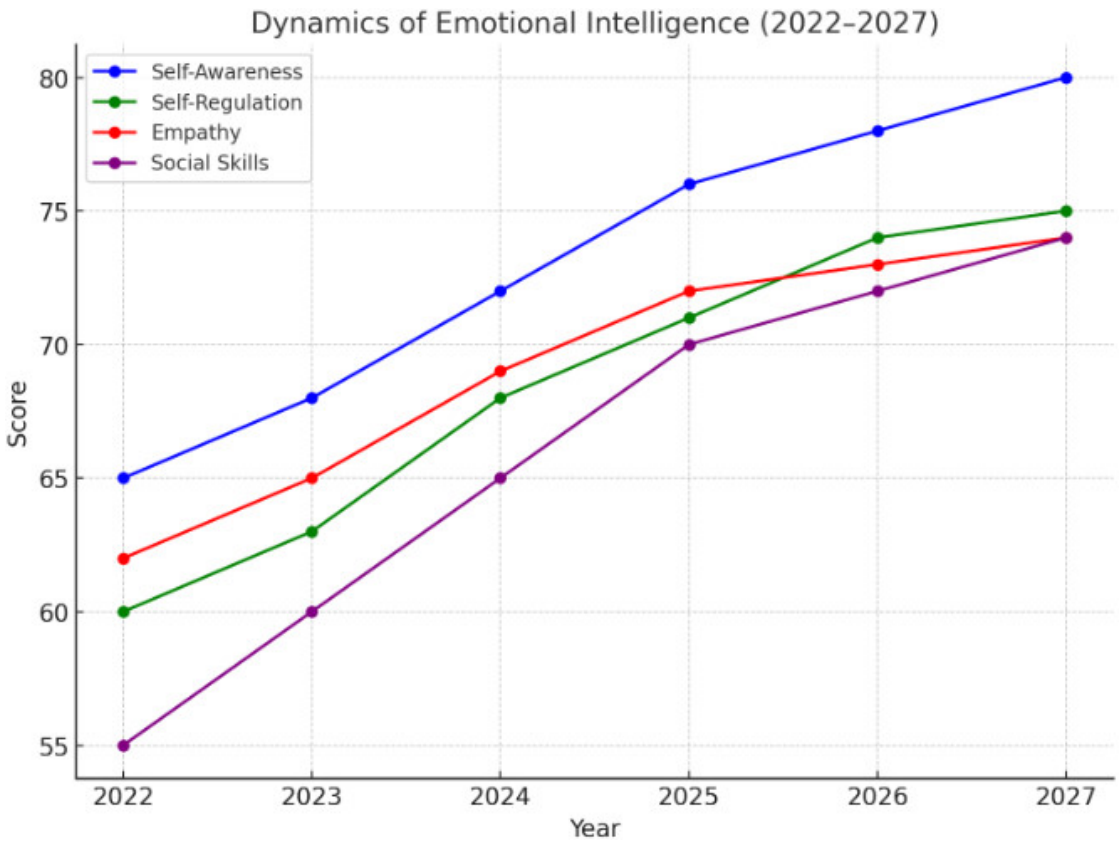

Fig. 1. *Dynamics of Emotional Intelligence Components (Self-Awareness, Self-Regulation, Empathy, Social Skills) over the period 2022-2027*
Source. Author's framework

To foster the development of emotional intelligence as a core competency for future managers, organizations should:

- integrate emotional intelligence training into leadership development programs – provide targeted training that focuses on self-awareness, empathy, and relationship management;
- promote a culture of emotional intelligence – encourage open communication, empathy, and respect within the organization to create a supportive environment for emotional growth;
- implement 360-degree feedback – collect feedback from peers, subordinates, and supervisors to provide individuals with a comprehensive understanding of their emotional intelligence strengths and areas for improvement.

While Table 1 delves into the development of emotional intelligence, Table 2 shifts the focus to another critical component of the SEAM-model: cognitive skills**.** By examining the interplay between cognitive skills such as critical thinking,

problem-solving, and decision-making, and emotional intelligence, we can gain a deeper understanding of how these competencies work in tandem to drive success.

Table 2 provides a systematic analysis of the relationship between cognitive skills and emotional intelligence, highlighting the importance of both for effective leadership and decision-making in complex organizational environments.

Table 2. *Developing Creativity within the SEAM-Model*

SEAM-Model Component	Soft Skill	Practical Tasks	Expected Outcome
Creativity	Idea generation, problem-solving, original thinking	Brainstorming, mind mapping, design thinking	Ability to generate new ideas, think outside the box
Critical Thinking	Idea evaluation, risk assessment	Case studies, business plan development	Ability to evaluate ideas, make informed decisions
Social Skills	Collaboration, communication of ideas	Teamwork, presentations	Ability to collaborate effectively, persuade others

Source. Analyzed and systematized by the author based on [4] - [5]

Table 2 demonstrates how the SEAM-model can be leveraged to nurture creativity and critical thinking. These two cognitive skills are increasingly recognized as essential professional competencies for innovation and problem-solving in modern organizations.

Figure 2 illustrates how the SEAM-model enhances the innovative potential of future managers during their professional development. The SEAM-model integrates socio-economic insights with a collaborative and problem-solving focus, creating an environment where managerial skills are nurtured alongside innovative thinking. This holistic approach ensures that future leaders are equipped to generate transformative ideas and implement them effectively.

Figure 2 highlights the significant impact of the SEAM-model on the innovative capacities of aspiring managers. The steady growth from 45 innovative ideas in 2022 to 85 in 2024 and the projected 95 ideas by 2027 underscores the model's ability to drive creative thinking and strategic decision-making. This upward trend demonstrates how the SEAM-framework empowers future managers to consistently deliver innovative solutions.

The SEAM-model's focus on fostering socio-economic awareness, critical thinking, and collaborative engagement ensures that these future managers are prepared to navigate complex organizational challenges. By leveraging these skills, they can implement transformative innovations, positioning themselves as effective leaders in dynamic and competitive industries.

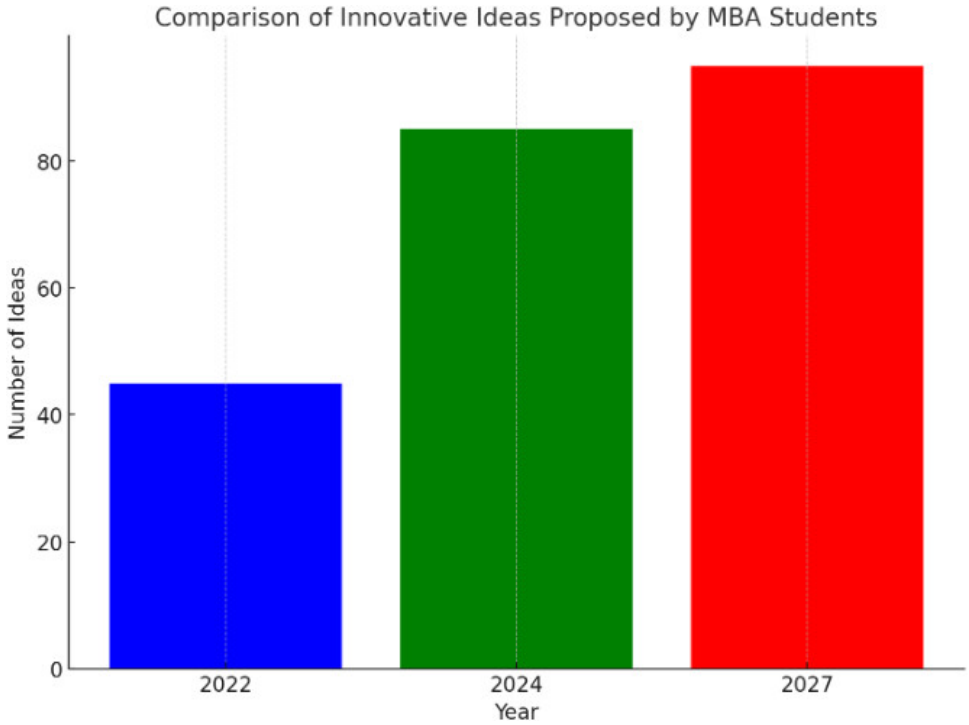

Fig. 2. *Comparison of the number of innovative ideas proposed by MBA managers in 2022-2027*
Source. Author's framework

By engaging in activities such as brainstorming and design thinking, individuals can develop the ability to generate novel ideas and explore unconventional solutions. This creative mindset is invaluable for driving innovation and adapting to change in a rapidly evolving business environment.

Furthermore, the development of critical thinking skills, such as analysis, evaluation, and problem-solving, empowers individuals to make informed decisions and solve complex problems. By applying critical thinking to creative ideas, individuals can identify the most promising opportunities and mitigate potential risks.

While creativity and critical thinking are essential for innovation, their effective application often requires strong soft skills. According to the SEAM-model, fostering these competencies involves aligning strategic goals with an enabling environment, actionable frameworks, and continuous feedback loops. Table 3 delves into the role of professional skills in fostering collaboration, effective communication, and leadership, highlighting how SEAM-components can guide the development of these abilities. By integrating soft skills with SEAM-principles, managers can not only enhance team performance but also ensure the sustainability of innovative solutions.

Table 3. *Developing Critical Thinking within the SEAM-Model*

SEAM-Model Component	Soft Skill	Practical Tasks	Expected Outcome
Critical Thinking	Analysis, evaluation, problem-solving	Case studies, data analysis, argumentation	Ability to analyze information, evaluate evidence, and solve problems
Creativity	Questioning assumptions, generating alternative solutions	Brainstorming, lateral thinking	Ability to think creatively and challenge the status quo
Social Skills	Effective communication, collaboration	Debates, group discussions	Ability to communicate ideas clearly and persuasively, work effectively in teams

Source. Analyzed and systematized by the author based on [6] and [7]

Table 3 provides a clear framework for developing critical thinking skills within the SEAM-model. This table highlights the interconnectedness of critical thinking with creativity and social skills.

- Critical Thinking itself is broken down into the sub-skills of analysis, evaluation, and problem-solving.
- Creativity is linked to critical thinking through questioning assumptions and generating alternative solutions.
- Soft Skills are tied to critical thinking through effective communication and collaboration.

By focusing on these interconnected skills, individuals can become more adept at analyzing information, evaluating evidence, and making sound judgments. This is particularly important for managers who must make decisions that have significant implications for their teams and organizations.

Recommendations for Professional Development of Managers

1. Foster a Culture of Critical Thinking

- Encourage questioning. Create a safe environment where employees feel comfortable challenging the status quo and asking probing questions.
- Model critical thinking. Leaders should demonstrate critical thinking in their own actions and decision-making.
- Promote diverse perspectives. Encourage teams to include individuals with diverse backgrounds and experiences to foster a broader range of perspectives.

2. Provide Opportunities for Practice

- Case studies. Use real-world case studies to help managers develop their analytical and problem-solving skills.
- Simulations. Create simulated business environments where managers can practice making decisions under pressure.
- Debates and discussions. Organize regular debates and discussions to encourage managers to articulate their thoughts and defend their positions.

3. Integrate Critical Thinking into Training Programs

- Embed critical thinking in all training. Ensure that critical thinking is a component of all management development programs.
- Use a variety of teaching methods. Employ a mix of lectures, group activities, and hands-on exercises to cater to different learning styles.
- Provide ongoing coaching and mentoring. Offer ongoing coaching and mentoring to help managers develop their critical thinking skills over time.

4. Encourage Collaboration

- Create cross-functional teams. Bring together individuals from different departments to work on projects together.
- Facilitate knowledge sharing. Encourage knowledge sharing through forums, communities of practice, and mentorship programs.

5. Measure and Reward Critical Thinking

- Develop performance metrics. Create performance metrics that measure critical thinking skills, such as the ability to analyze complex problems and develop innovative solutions.
- Recognize and reward critical thinking. Recognize and reward employees who demonstrate strong critical thinking skills.

Figure 3 provides an analytical framework to understand the development of creativity across key competencies among future managers. Grounded in the SEAM-model, this chart contrasts professionals with experience in startups and large corporations. The SEAM-framework integrates socio-economic dynamics, encouraging adaptability and innovation in diverse organizational settings. This comparison highlights how managerial environments shape critical skills such as creativity, critical thinking, problem-solving, and teamwork.

The radar chart in Figure 3 reveals distinct trajectories of competency development. Professionals with startup experience demonstrate higher creativity and adaptability due to exposure to dynamic and resource-constrained environments. Conversely, managers from large corporations exhibit stronger teamwork and problem-solving skills, reflecting the structured and collaborative nature of such organizations.

The SEAM-model plays a critical role in bridging these developmental differences. By integrating its principles into professional training, organizations can foster a balanced skill set that combines startup-driven innovation with corporate-level strategic thinking. This holistic approach ensures that managers are well-equipped to lead in both entrepreneurial and established business settings, thereby maximizing their overall impact on organizational success.

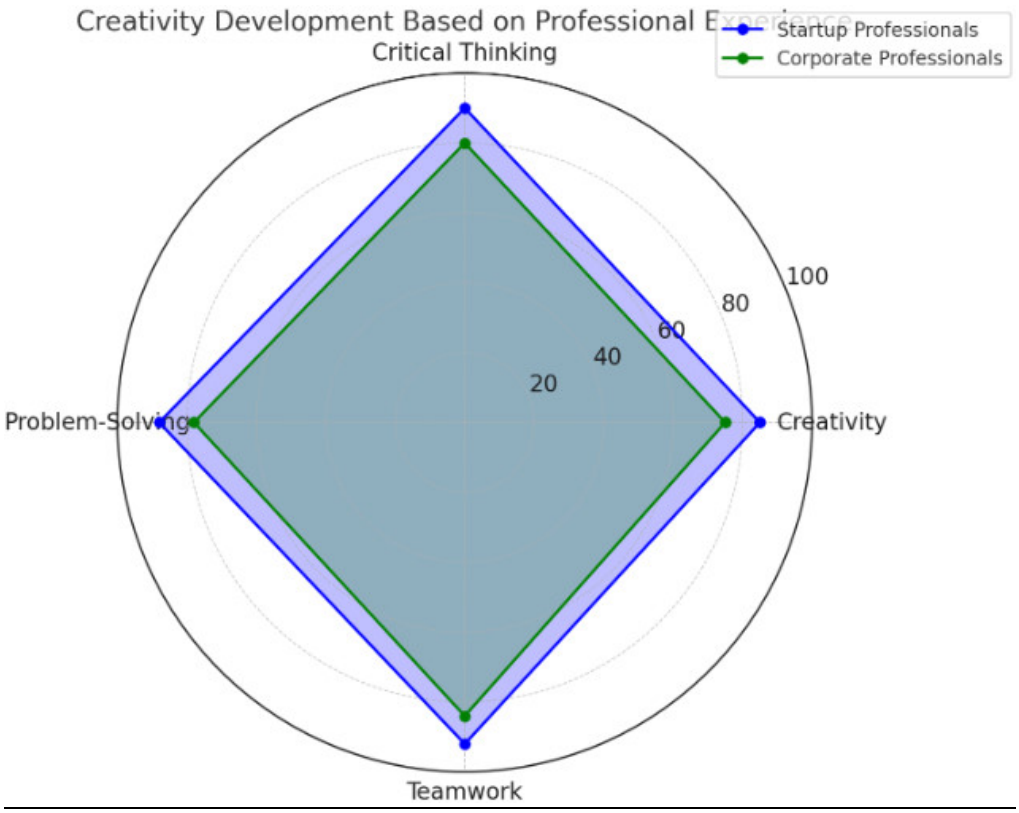

Fig. 3. *Creativity development across key competencies, contrasting professionals with startup experience and those from large corporations*
Source. Author's framework

The SEAM-model, which focuses on developing social intelligence, emotional intelligence, and critical thinking, is highly relevant for the professional development of future managers in the context of the transition to Society 5.0. In this society, where technology and people interact harmoniously, leaders require not only technical knowledge but also a high level of emotional intelligence and the ability to work in teams. The SEAM-model offers a comprehensive approach to developing these qualities, preparing future managers for work in a dynamic and uncertain world. The SEAM-model has great potential for the development of future managers. It helps them develop competencies such as leadership, creativity, problem-solving, collaboration, and empathy, which are becoming essential components of professional competence. These competencies are key to success in any field, especially in an environment of rapid change and globalization. Author has analyzed the strengths and weaknesses of the SEAM-model's impact on the development of professional competence in future managers, considering the threats/risks and opportunities to turn challenges into advantages (Table 4).

Table 4. *SWOT Analysis of SEAM-Model and Development of Soft Skills in Future Managers*

Strengths	Weaknesses	Opportunities	Threats
Comprehensive approach: Addresses emotional intelligence, critical thinking, and creativity	Requires significant resources and time for implementation	Aligns with the demands of the modern job market	Rapid technological advancements may render some aspects obsolete
Practical orientation: Provides specific tools and techniques for skill development	Limited research on the model's impact on soft skills	Potential for collaboration with businesses to provide real-world experience	Competition from other competency development models
Emphasizes social responsibility and teamwork	Effectiveness depends on the quality of training and facilitation	Opportunities for innovative teaching methods using digital tools	Lack of student motivation may hinder learning outcomes
Fosters adaptability and resilience	May be challenging to measure the outcomes of the model	Potential for creating a network of alumni with strong soft skills	Changing priorities of employers may shift focus to other skills

Source. Analyzed and systematized by the author

Table 4 provides a comprehensive overview of the strengths, weaknesses, opportunities, and threats associated with the SEAM-model. By understanding these factors, organizations can effectively implement and leverage the model to develop future managers.

Strengths such as the model's comprehensive approach and practical orientation make it a valuable tool for addressing the complex challenges of the 21st century. By focusing on emotional intelligence, critical thinking, and creativity, the SEAM-model equips individuals with the skills needed to thrive in a rapidly changing world.

However, the weaknesses of the model, such as the resource intensity and limited research, must be acknowledged and addressed. To overcome these challenges, organizations should invest in high-quality training and evaluation methods.

The opportunities presented by the SEAM-model are significant, particularly in the context of post-war reconstruction. By fostering innovation, collaboration, and adaptability, the model can contribute to the development of a resilient and prosperous society.

To mitigate the threats identified in the SWOT analysis, organizations should stay updated on the latest trends in education and training, and continuously adapt the SEAM-model to meet the evolving needs of the workforce.

Given the challenges faced by Ukraine, the SEAM-model offers a promising framework for developing future leaders who can contribute to the country's recovery and reconstruction.

The series of graphs (Fig.4) collectively illustrates the multidimensional development of future managers through the lens of the SEAM-model. This model emphasizes a systemic and integrative perspective, enabling an evaluation of the

dynamic interplay between emotional intelligence, creativity, and innovative thinking across various professional contexts. The visualizations aim to underscore how tailored approaches, rooted in SEAM-principles, can prepare managers to excel in rapidly evolving environments by enhancing both personal and organizational competencies.

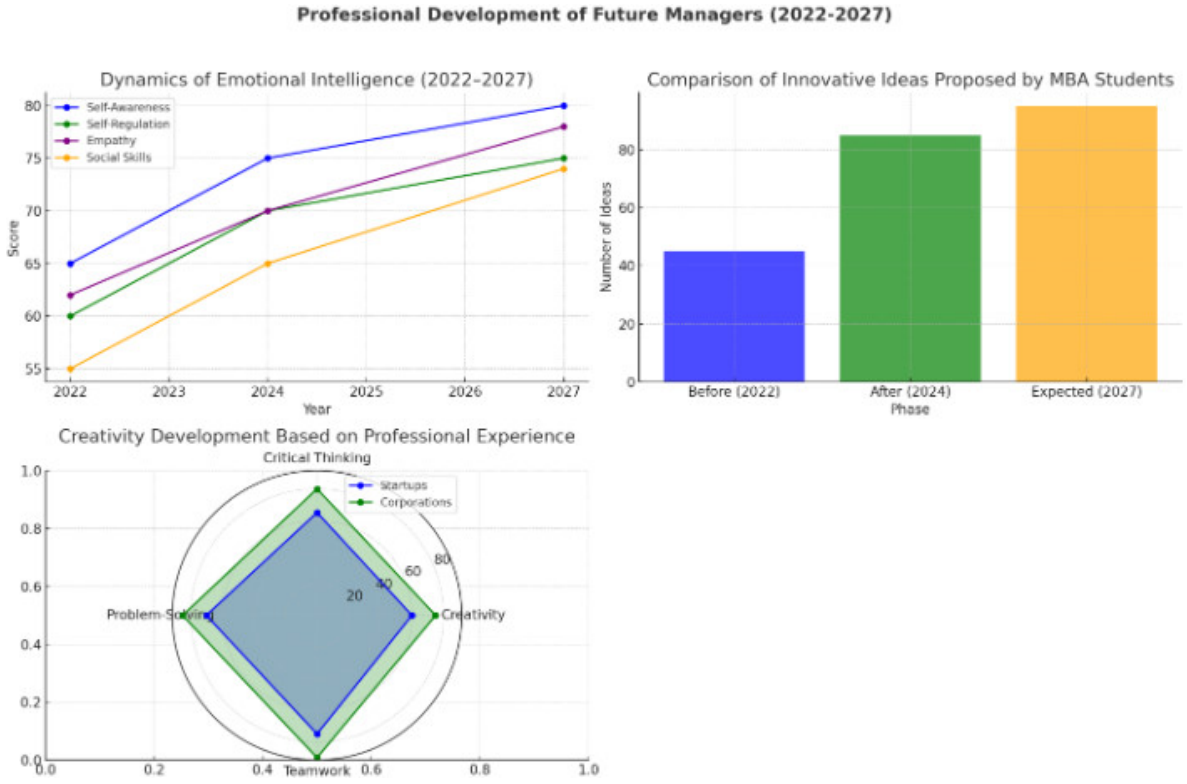

Fig. 4. *Evolution of Skills Across Professional Experience*
Source. Author's framework

The data collectively validates the SEAM-model's ability to cultivate future managers equipped for complex, adaptive challenges. By promoting a balance between emotional intelligence, critical thinking, and creativity, the SEAM-framework ensures that managerial development aligns with real-world demands. The upward trends in emotional intelligence and creativity signify the growing capacity of managers to handle diverse scenarios with empathy, innovation, and strategic insight.

Moreover, the comparative analysis of professional experiences in the radar chart suggests that the SEAM-approach can integrate the agility of startup environments with the structured problem-solving skills prevalent in corporations. This synergy reinforces the role of SEAM in guiding professional training, ensuring that future managers are not only proficient in traditional competencies but also prepared to lead with resilience and vision in a constantly evolving global economy.

Specific recommendations include:

1. Prioritize the development of soft skills. Focus on cultivating emotional intelligence, critical thinking, and creativity, as these skills are essential for effective leadership and problem-solving in complex situations.
2. Integrate the SEAM-model into educational programs. Incorporate the principles of the SEAM-model into university curricula and corporate training programs to ensure that future managers are equipped with the necessary skills.
3. Foster a culture of innovation and learning. Create a work environment that encourages experimentation, risk-taking, and continuous learning.
4. Invest in technology and digital tools. Leverage technology to enhance the effectiveness of the SEAM-model, such as through online learning platforms and virtual simulations.
5. Build strong partnerships. Collaborate with businesses, government agencies, and international organizations to share best practices and resources.
6. Monitor and evaluate the impact of the SEAM-model. Regularly assess the effectiveness of the model and make necessary adjustments to ensure its continued relevance.

By implementing these recommendations, Ukraine can leverage the power of the SEAM-model to build a strong and resilient future.

Conclusions

In the ever-changing landscape of the modern world, Ukraine faces an unprecedented challenge of rebuilding its economy while simultaneously adapting to global trends such as digitalization and innovation. In this context, the SEAM-model emerges as a transformative approach to leadership and management development. By combining soft skills, emotional intelligence, and adaptability with digital literacy, the model addresses the growing demands of Society 5.0, where human-centric technologies and innovative solutions take precedence. This model not only equips future leaders to navigate uncertainty but also empowers them to foster environments of creativity, resilience, and collaboration in the workplace.

As Ukraine works toward becoming a leader in the global innovative economy, the SEAM-model offers a strategic framework for achieving sustainable growth. It bridges the gap between professional education and industry needs, ensuring that graduates are not only highly qualified but also capable of addressing the complex problems of today and tomorrow. It is critical that both academia and industry work together to integrate this model into their practices to create a unified approach to cultivating a new generation of managers who are equipped to handle challenges, embrace change, and contribute to national progress.

1. The SEAM-model offers an innovative approach to developing leaders. It goes beyond traditional management models, focusing on cultivating emotional intelligence, social skills, and empathy. These attributes are crucial for building trust within teams and creating sustainable organizational growth.
2. The SEAM-model aligns with the demands of Society 5.0, where innovation and adaptability are key success factors. It prepares leaders to operate in

dynamic and uncertain environments, fostering resilience and the ability to thrive in complexity.

3. The application of the SEAM-model fosters innovative thinking among future managers. It encourages a creative approach to problem-solving, empowering leaders to generate breakthrough ideas and solutions for both immediate and long-term challenges.

4. The SEAM-model can be a driver of organizational innovation. It helps create a culture of innovation where employees feel engaged, motivated, and inspired to contribute their best efforts toward shared goals.

5. Integrating the SEAM-model into educational programs enables the development of professionals who meet the demands of the modern job market. Graduates who have mastered the SEAM-model will be more competitive in the global market, gaining an edge due to their unique blend of technical and interpersonal skills.

6. The SEAM-model can be an effective tool for organizational transformation. It helps to change an organization's culture, making it more people-oriented, innovative, and capable of attracting and retaining top talent.

7. The use of digital technologies within the SEAM-model opens up new opportunities for learning and development. Online platforms, virtual reality, and other innovative tools can significantly improve learning efficiency and enable immersive, real-world training experiences.

8. The SEAM-model can contribute to the development of a startup ecosystem. By fostering entrepreneurial skills such as risk-taking, adaptability, and creative thinking, it encourages the creation of new businesses and supports innovation-driven economic growth.

9. The innovative nature of the SEAM-model requires continuous development and adaptation. It is important to track new trends in management, technology, and education to refine the model and maintain its relevance in a rapidly evolving world.

10. The SEAM-model can become a national project that contributes to the development of Ukraine's innovative economy. Due to its innovation and relevance, the SEAM-model can become one of the tools for modernizing the Ukrainian economy, making it a hub for creativity, technology, and global competitiveness.

The SEAM-model is more than a tool for addressing current challenges; it is a vision for the future of Ukrainian leadership and economic development. Rebuilding Ukraine's economy and developing professional education is not merely a task but a shared responsibility to future generations. Soft skills, such as emotional intelligence, critical thinking, creativity, and adaptability, are becoming the cornerstone of this vision, equipping managers to not only rebuild what has been lost but also innovate for a brighter future.

To achieve these goals, it is crucial that both public and private sectors invest in the education of future leaders. Collaboration between academia, government, and industry can ensure that the SEAM-model becomes an integral part of Ukraine's national strategy for development. This unified approach will not only enhance

Ukraine's position in the global economy but also inspire a new generation of innovators and entrepreneurs who will build industries capable of leading on the global stage.

In these challenging times, it is essential to look beyond immediate solutions and focus on building long-term resilience and adaptability. The SEAM-model provides a roadmap for such a transformation, allowing leaders to navigate uncertainty with confidence and creativity. Ukraine's future, a future of Society 5.0 where humans and technology work together for a better tomorrow, depends on the strategic integration of models like SEAM. Together, we can ensure that Ukraine not only recovers but thrives as a global leader in innovation and human-centered progress.

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PROSPECTS OF LEGAL REGULATION OF EDUCATIONAL AI RELATIONS

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In recent years, the introduction of artificial intelligence (hereinafter - AI) in the educational sphere has become not only a technological trend, but also an important stage in the development of the education system. AI can transform traditional teaching methods, improving the effectiveness of the educational process and adapting it to the individual needs of both education seekers and subjects of educational activity (hereinafter referred to as SOD). AI technologies can provide personalized learning, automate the assessment of knowledge and analyze educational data, which in turn contributes to the improvement of the quality of education. However, along with potential advantages, new challenges arise, including in the field of legal regulation of AI-relations.

As AI technologies become more common, it is important to consider the legal regulations that govern their use. This includes the issue of personal data protection (hereinafter referred to as Personal Data Protection), copyright on AI objects, as well as ethical aspects related to learning automation. In this context, there is a need for a detailed analysis of the legal field related to the use of AI in education in order to ensure optimal efficiency and safety of its implementation.

In the process of research, it is proposed to consider modern legal norms, challenges and prospects that will allow to optimize the implementation of AI in education, while ensuring compliance with legal prescriptions and ethical standards.

The implementation of AI in the educational sphere shows rapid development, because AI technologies are becoming more and more accessible and diverse. Educational institutions actively integrate these technologies into the educational process in order to increase the effectiveness of education, adapt materials to the needs of students and simplify administrative tasks [1].

The current state of implementation of AI in education demonstrates the active use of relevant technologies in educational institutions of various levels. In

particular, AI is used to personalize the educational process, automate administrative tasks, analyze educational data, and improve interaction between providers and recipients of educational services. Innovative AI platforms allow creating individualized learning trajectories, adapting materials to the needs and capabilities of each student [2].

When conducting an overview of the use of AI in the SOD, it is worth noting that today there are many platforms and tools that provide interactive learning. For example, adaptive learning systems analyze the progress of students and automatically adjust the difficulty of tasks, which increases the effectiveness of learning [3]. Such technologies as chatbots are actively used to provide consultations, answering the questions of applicants in real time.

In addition, computer vision technologies are used to analyze the behavior of students during classes, which can help teachers identify learning problems. The use of virtual and augmented reality in the educational process has also become popular due to its ability to create interactive and engaging learning environments. Thus, the implementation of AI in education opens up new horizons for education, increasing its effectiveness and accessibility.

The legal basis for the implementation of AI in the educational sphere is critically important to ensure the ethical, safe and effective use of these technologies. National legislation should provide a legal framework for the implementation of AI in education, where important elements are, first of all, acts of educational legislation. Yes, the current Law of Ukraine "On Education" in mid-2022. was supplemented by Art. 74-1, which establishes the legal regime of the automated information complex of educational management, but there is no mention of the use of AI at the moment. Instead, the Concept of AI development in Ukraine [4], emphasizing the need to develop a single coordinated state policy aimed at solving priority problems, singles out among the latter: - the absence or imperfection of legal regulation of AI, including in the field of education; – insufficient level of quality of higher education and educational programs aimed at training specialists in the AI field in institutions of higher education (hereinafter - higher education institutions); – lack of modern training programs for higher education teachers in the AI field; – low level of investment in AI research in higher education institutions, etc. In addition, it is believed that educational legislation should contain provisions that allow the use of the latest technologies in educational processes, including AI, as well as determine exactly how intelligent systems can be integrated to automate learning or evaluate students.

At the same time, the legislation on ZPD, which is a constituent institution of information legislation, should play a key role in the regulation of AI relations, since such laws as the General Data Protection Regulation (EU) 2016/679, hereinafter - GDPR) in the EU or the Law of Ukraine "On the Protection of Personal Data" regulate legal relations related to processing and personal data protection, which can be classified as confidential information [5]. This is especially relevant in the context of the use of AI, since many technologies require access to large amounts of data. National authorities should also develop ethical codes that will determine the rules of conduct of

participants in the educational process in connection with the use of AI, in order to ensure fairness, transparency and accountability in educational AI relations.

In particular, the Concept of the State targeted scientific and technical program for the use of AI technologies for the period until 2026. [6] determined that education, vocational training, and science are priority areas in which the tasks of state policy regarding the development of the AI industry are fulfilled. Among the ways and methods of solving modern problems, the creation of AI-centers or AI-laboratories on the basis of scientific institutions and higher education institutions, consulting enterprises that will provide services for the development, testing, and training in the use of AI-technologies is foreseen. For this purpose, the Ministry of Digital Transformation of Ukraine has developed a Roadmap for the regulation of AI in Ukraine (Bottom-Up Approach), in which it was declared that there is no desire to regulate the AI market, instead – to find a balance between the interests of business and ensuring an adequate level of protection of citizens from AI risks. Sooner or later, Ukraine will have to implement AI-acts of the EU as one of the conditions of European integration in the digital sphere.

The first practical European step towards strengthening legal standards in the field of development and use of AI was the adoption on February 17, 2017. Resolutions of the European Parliament on the civil-law regulation of robotics [7], which emphasize the need to develop general concepts of the terms "cyber-physical systems", "intelligent autonomous robots" taking into account such features as: - the ability to be autonomous and exchange data; – ability to learn based on acquired experience; - availability of minimal physical support; - the ability to adapt to the external environment; - lack of life.

In addition, at the international level, there are numerous documents and recommendations that help regulate the implementation of AI in education. For example, UN conventions and UNESCO guidelines emphasize the importance of access to education, and UNESCO guidelines on the use of new technologies in education provide a framework for ensuring the ethical and equitable use of AI. International organizations, such as the Organization for Economic Co-operation and Development, are developing guidelines for the implementation of innovations in SOEs, which may include the use of AI. Also, international associations working in the field of education can develop ethics standards that ensure the ethical use of AI in the educational process [8].

A year ago (November 2023), during the first ever international AI Safety Summit held in Great Britain, Ukraine signed "The Bletchley Declaration", the main goal of which is to activate the international cooperation in the field of AI-security research.

Finally, on August 1, 2024. the innovative EU Regulation on the Regulation of AI (The EU AI Act) entered into force, which introduced a risk-oriented approach to the application of AI technology. However, low- or no-risk technologies will not fall under the regulation, but a subset of potential AI applications classified as high-risk, such as biometrics and facial recognition, AI-based medical software or AI used in areas such as education and employment, must be registered in the EU database

and comply with the requirements for risk management and quality with the possibility of passing a regulatory audit [9].

Therefore, the implementation of AI in the educational sphere is accompanied by numerous legal challenges and risks that require careful analysis and regulation. One of the main problems is the confidentiality and privacy of education seekers. The use of AI technologies involves the collection, processing and storage of a large amount of personal information, which increases the risks of unauthorized access or misuse of data [10]. This applies in particular to systems that analyze educational achievements, behavior and other aspects, which may violate the fundamental rights and freedoms of applicants, namely, the right to non-interference in their personal life. In this regard, when regulating this block of educational and information relations, it is important to ensure compliance with the norms of national and international legislation on personal data protection, including GDPR.

The second significant legal problem is the issue of intellectual property, in particular the authorship of educational materials created with the help of AI. When AI generates educational content, it becomes difficult to determine the rights to these works. Is the author the person who developed the algorithm, or the system itself, which performed the creative process? The answer to this question requires new legal norms that would clearly define who owns the rights to AI products in order to avoid legal disputes and ensure fair compensation for all participants in the creative process.

Defining standards of ethical behavior for the use of AI in education is also an important task. Standards may include principles of fairness, transparency, accountability and non-discrimination. For example, HEIs can develop codes of ethics that clearly define how AI can be used to support the educational process while protecting the interests of learners. These codes should also include requirements for privacy, non-discrimination and accessibility of technology for all users, regardless of their physical, social and economic status.

An important component of ethical regulation is also raising the awareness of educational institutions and students about the potential ethical risks associated with the use of AI. This may include training on ethical issues, conducting seminars, and creating informational materials that will help participants in the educational process better understand how to properly use AI technologies while maintaining ethical principles [11].

Further, given the rapid development of technologies, proposals for improving legal norms should include the creation of mechanisms for monitoring and evaluating the impact of AI on educational processes. Therefore, it is necessary to develop and adopt normative acts that will regulate the audit procedures of AI technologies used by the SOD. Regulated inspections should ensure the compliance of AI technologies with ethical standards and legal norms, as well as allow timely identification of possible risks.

Thus, the prospects for legal regulation of the introduction of AI in education are the need to adapt legislation to new technologies, develop new control

mechanisms, and improve legal norms that would ensure the effective and ethical use of AI in the educational process. This will not only improve the quality of education, but also protect the rights and interests of all participants in the educational environment.

Thus, the analysis of the legal aspects of the introduction of AI in the educational sphere made it possible to draw several key conclusions. First, the implementation of AI in education opens up new opportunities for improving the educational process, but at the same time it raises a number of legal challenges, such as issues of privacy, personal data protection, and intellectual property issues. Secondly, the current legislation frankly does not keep up with the rapid changes in AI technologies, which requires an urgent legal response.

In addition, the issue of ethical regulation is important, because ethics and law must work in close relationship to ensure not only technological progress, but also the protection of the rights of all participants in the educational process. Lack of clear standards can lead to abuse and negative consequences. In this regard, for further research and development in the field of legal regulation of AI in education, it is recommended:

1. Analysis of existing legislation to identify gaps and shortcomings in the context of AI implementation, implementation of European AI legislation.
2. The development of new legal norms that take into account the specifics of the use of AI in education, in particular, regarding the processing of personal data and copyrights to educational materials.
3. Creation of interdisciplinary groups that will bring together lawyers, educators and representatives of technology companies to jointly develop standards of ethical and legal regulation.
4. Conducting educational campaigns to raise the awareness of SOD and education seekers about rights and responsibilities in connection with the use of AI.
5. Integration of ethical norms into the legal regulation of the use of AI in education in order to ensure a balance between innovation and ethical standards.

These recommendations will help promote the effective and safe use of AI in the educational sphere, as well as ensure legal and ethical protection of all participants in the educational process.

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ETHICAL DILEMMA OF THE USE OF ARTIFICIAL INTELLIGENCE IN SCIENTIFIC RESEARCH AND INNOVATION

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Artificial intelligence (AI) is becoming an important component of modern scientific research and innovation. Its implementation provides new opportunities for automation of complex processes, analysis of large volumes of data, optimization of resources and acceleration of discoveries in various fields of science [1]. AI allows scientists to conduct experiments faster, model complex processes, and generate new hypotheses that could have gone unnoticed without its help [2]. However, along with the potential benefits of using AI, there are also new ethical challenges related to researcher autonomy, responsibility for scientific results, transparency of algorithms, and risks of model bias. This makes the analysis of ethical dilemmas related to the use of AI in science and innovation critically important for the development of science and society in general.

The main goal of this article is to analyze the key ethical dilemmas that arise in the process of applying AI in scientific research and innovation. The article discusses the issues of responsibility for the results of scientific research performed using AI, the transparency of algorithms and models, issues of data confidentiality, as well as possible risks of bias arising from unethical or uncontrolled use of AI. In addition, the prospects and challenges related to the regulation of the implementation of AI in scientific activity are analyzed.

Today, AI is actively used in many fields of science – from biology and medicine to physics, engineering and social sciences. In particular, machine learning technologies make it possible to identify patterns in large volumes of data that are difficult to analyze using traditional methods. This contributes to new scientific discoveries, especially in the field of genetics, materials science, ecology and medicine. In innovation, AI helps develop new products and optimize production processes, leading to increased efficiency and reduced costs. However, along with these achievements, new ethical issues arise related to human autonomy,

responsibility for AI decision-making, transparency of models, and impact on social inequalities [3].

AI is not only changing scientific research, but also accelerating innovation processes in many industries. In industry, artificial intelligence helps optimize production processes, create new products and services, reducing development time and time to market. In the automotive, pharmaceutical, technological and other fields, AI is used for modeling, optimization, analysis of big data and even creation of innovative prototypes. For example, in the field of technology, AI helps speed up the research of new materials or the development of artificial proteins in biology, which previously took years.

One of the main advantages of using AI is its ability to increase the accuracy of scientific research and innovation [4]. Automated AI algorithms can provide more accurate results, minimizing the impact of human factors and errors (table 1). This is especially important in fields where accuracy is critical, such as medicine or environmental research. Another important advantage is a significant reduction in research time – thanks to the processing of huge amounts of information, AI can quickly find correlations and trends that a person could not detect in such a short time. Finally, AI opens new opportunities in data analysis, allowing to find new patterns and derive new hypotheses, which can become the basis for further scientific discoveries and innovations.

One of the main ethical dilemmas is that excessive automation of scientific research and innovation processes can reduce the autonomy of the scientist. Using AI to automate large parts of research can lead to a loss of creative control and human involvement at critical stages. This raises the question of whether scientists can trust the decisions made by algorithms, and whether this will reduce the value of human experience and intuition in scientific and innovative activities.

Table 1. *Individual and collective benefits of AI in research from thematic analysis of (n = 25) participants [5]*

Individua Benefits	Collective Benefits
Help with narrow mundane tasks	Support impact and engagement
Boost research productivity	Build connections for interdisciplinarity
Increase speed and access to big data	Stakeholder benefit: publics, partners and learners
Boost academic promotion through greater productivity and access to large datasets	Support research informed teaching
Improve knowledge navigation and information retrieval	Promote open innovation
Speed up decision-making	Highlight cultural and access issues and biases
Freedom for blue skies research	Invoke values and principles

Another dilemma concerns the question of responsibility for the results obtained with the help of artificial intelligence. If AI makes a mistake or leads to wrong conclusions in a scientific study or innovation process, the question arises: who is responsible – the developers of the algorithms, the researchers who used the

AI, or the companies that implemented it in their work? This is especially important in industries where even minor mistakes can have serious consequences, such as medicine or pharmaceuticals.

In the case of innovations created with the help of AI, complex questions arise regarding intellectual property. If an AI algorithm is able to generate new inventions or innovations without direct human intervention, it is not clear who is the author – the developer of the algorithm, the user who launched it, or the system itself. This raises legal and ethical questions about the ownership and rights of inventions created with the help of artificial intelligence and requires a new approach to the regulation of intellectual property in the context of modern technologies.

With the use of AI in scientific research, an important ethical dilemma arises – whether research participants should give separate consent to the use of artificial intelligence algorithms to process their data. Traditional ethical norms require informed consent, but in the case of AI, participants may not understand the full extent of the use of their data and the possible risks associated with automated information processing (fig. 1). Participants must be clearly informed about exactly how their data will be used by artificial intelligence, what decisions will be made based on their data, and what risks this may pose to them.

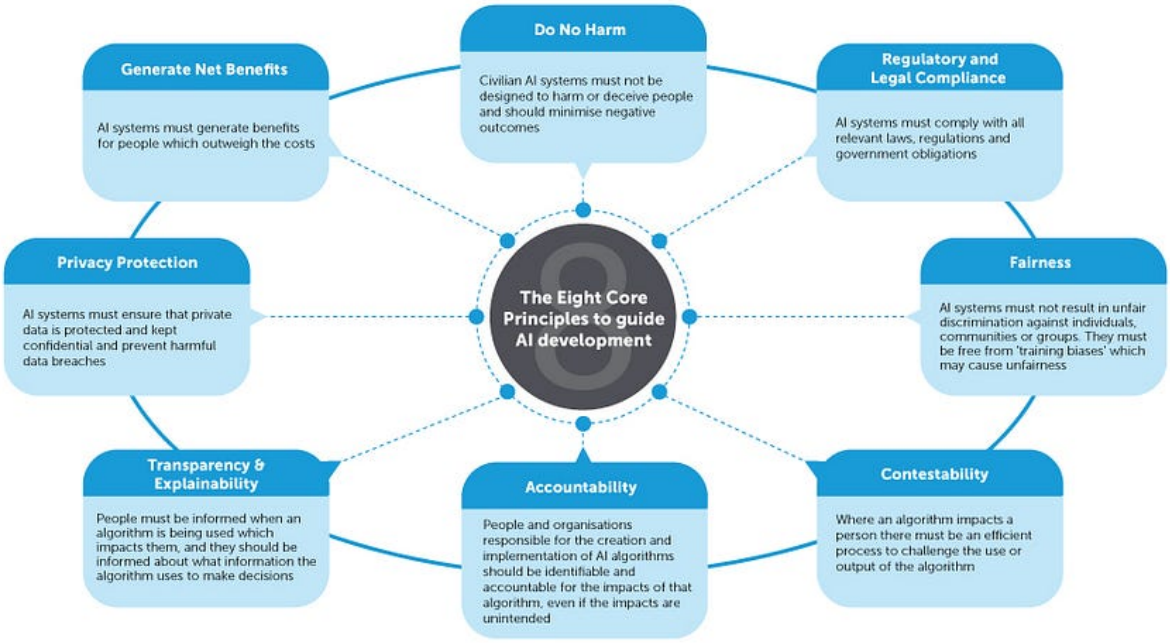

Fig. 1. *Example of an ethical framework [6]*

Artificial intelligence significantly increases the ability to analyze large volumes of data, which is important for scientific research. However, the use of personal data creates significant privacy risks [7]. AI can process information in a way that makes possible the reverse identification of participants even after the data

has been anonymized, which violates privacy rights. This necessitates the provision of adequate data protection measures, including cryptographic methods, access control and close supervision of who is authorized to use AI-processed data.

Today, various countries and international organizations are developing ethical standards and legal frameworks aimed at ensuring the responsible use of AI in science and innovation. For example, the European Union actively promotes its own ethical principles, enshrined in its AI White Paper and Ethical Guidelines for Artificial Intelligence, which focus on transparency, accountability and non-discrimination. Also, the UN and UNESCO published documents calling for the ethical use of technologies, including AI, to achieve the goals of sustainable development. In addition, various industry associations and academic institutions are developing their own codes of ethics for the use of AI in scientific research (fig. 2).

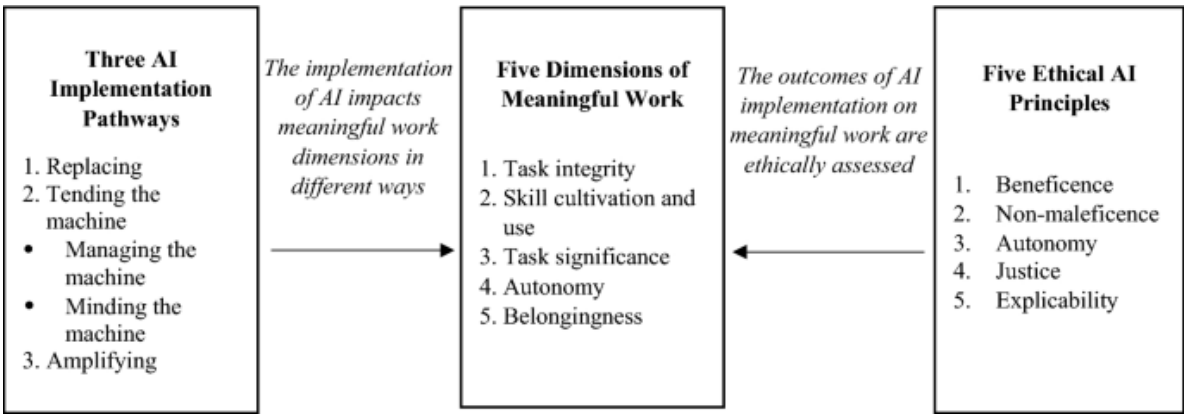

Fig. 2. *Overview of conceptual framework [8]*

However, regulations at the international level still remain fragmented, and there is no single, globally recognized standard for the ethical use of AI in science. There is a need to harmonize these approaches to avoid legal uncertainty and ensure global cooperation in research and development.

In addition, given the global nature of scientific research, new intergovernmental mechanisms of control and cooperation are needed, which would cover the ethical and legal aspects of the use of AI. Such mechanisms could include international commissions to assess the risks of new technologies, the development of common standards for scientific publications using AI, and the creation of ethical audits to monitor compliance with scientific research.

Ways to minimize ethical risks:

1. One of the effective ways to minimize ethical risks is to develop and implement clear ethical codes that would regulate the use of AI in scientific research and innovation. Such codes should outline ethical standards, regarding accountability, transparency, objectivity and data protection. They should also include recommendations for avoiding bias in algorithms and ensuring reproducibility of studies. The creation of such documents will promote compliance

with ethical principles in research activities and help regulate the use of AI at all stages of development.

2. In order to effectively control the ethical use of AI, it is important that regulation is collaborative and involves all key stakeholders: the scientific community, governments and technology companies. Interaction between these groups will contribute to the creation of harmonized standards and control mechanisms, which will avoid legal gaps and ensure accountability of developers and users of AI. Technology companies should actively participate in the development of ethical standards, by creating mechanisms to audit algorithms and ensure transparency of their models.

3. It is important that scientists and innovators are aware of the ethical challenges that arise when using AI. Conducting seminars, training and educational programs on the ethics of AI will contribute to increasing their awareness and understanding of the ethical implications of their research. This will allow scientists to be more deliberate in developing algorithms, avoid potential biases, and ensure responsible use of technology.

Conclusions. The use of artificial intelligence in scientific research and innovation is accompanied by several ethical dilemmas that require serious attention. The main ones include excessive automation, which can threaten the autonomy of researchers; issues of responsibility for results obtained using AI; algorithm transparency problems; risks of bias in models; as well as intellectual property issues. These dilemmas emphasize the difficulty of integrating AI into scientific and innovative activities, because they can significantly affect the quality and reliability of the results obtained.

The importance of finding a balance between technological progress and ethical standards cannot be underestimated. AI technologies can significantly improve research efficiency, but their implementation must be accompanied by clear ethical principles governing their use. Only in this way can it be ensured that achievements in the field of AI will be used for the benefit of society, without violating ethical norms.

For further research and development in the field of ethical regulation of AI, it is necessary to focus on the creation of universal ethical codes, the development of interdisciplinary research that combines technology and ethics, as well as on the improvement of control mechanisms for the use of AI. This will ensure the ethical use of technologies, minimizing risks and maximizing the positive impact of AI on scientific activity and innovation.

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DIGITAL TRANSFORMATION: FROM INFORMATIZATION TO ARTIFICIAL INTELLIGENCE IN ADMINISTRATIVE SERVICES IN UKRAINE

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Abstract. The study identifies and substantiates the periods of digital transformation and introduction of artificial intelligence in administrative services in Ukraine with a focus on regulatory and legal support. The periods of digital transformation in Ukraine are divided into informatization (1991-2000), digitalization (2000-2019), and digital transformation (2019-present). Informatization includes the creation of national information systems and telecommunications infrastructure. Digitalization is characterized by data integration and process automation, such as the launch of e-government, e-democracy, decentralization, and automation of public services. Digital transformation includes the strategic restructuring of social and business processes using technologies such as the Internet of Things, artificial intelligence, cloud computing, big data, and others. To formulate the periods of digital transformation, we considered global trends in the development of AI in the world. Several periodization's were taken into account, including the ten-year periodization of AI development, which covers key stages: from its inception in the 1950s, the ups and downs of public interest in the 70s and 90s, to the modern era of large language models. Another periodization, based on technological and investment criteria, identifies such stages as the formation of machine intelligence, the heyday of expert systems, the "winter of AI," the era of deep learning, and the "spring of AI." This study highlights the complexity and multifactorial nature of the processes of AI formation and digital transformation. Particular attention is paid to the analysis of the legal and regulatory framework in these areas in Ukraine. This makes it possible not only to assess the achievements but also to identify potential vectors of development in the context of sustainable development.

Keywords: digital transformation, artificial intelligence, administrative legal relations, administrative services, automation, informatization, digitalization, information law, sustainable development.

In the scientific literature, there are several characteristics and time intervals for the formation and development of artificial intelligence (AI) technologies. These are the ten-year periodization of AI development, the technological and investment periodization, and the four-stage periodization. The criteria for determining the

beginning of a period and its end are based on various factors. Let us briefly analyse these three periodization's.

1. The ten-year periodization of AI development will include the following periods.

1950`s — the beginning of the AI era.
1960`s — a period of optimistic expectations.
1970`s — the winter of AI.
1980`s — revival.
1990`s — revolution in computing.
2000`s — the beginning of a new wave.
2010`s — the era of deep learning.
2020`s — AI in everyday life.

The criteria for establishing the period are the destylite period of time, and the name of the period is associated with technological breakthroughs or the decline of public interest in the development of AI technologies.

2. **The technological and investment periodization of AI development has other periods:**

1930-1940 - the ideological stage, the human brain as an electrical network of neurons that can be reproduced.
1941-1948 — algorithmic and cybernetic formation of machine intelligence.
1956-1974 — birth of AI at the Dartmouth Seminar.
1974-1980 — the first AI winter.
1980-1987 — emergence of expert systems and neural networks.
1987-1993 — the second AI winter.
1993-2010 — intelligent agents and imperceptible mass integration of AI.
2011-present - the era of massive AI adoption.
2011-2015 — deep learning and big data.
2016-2024 — the spring of AI and big language models.

In this periodization, the beginning and end of a certain period are determined by various factors. These include the availability of large funding for AI projects; development of new mathematical methods of computing; identification of data dependence for scaling projects, which was a prerequisite for losing interest in AI development; formation and completion of the cycle of expectations; emergence of next-generation computers (personal computers with high power instead of special hardware); emergence of breakthrough scientific publications with new hypotheses about the potential of AI; victories in intellectual games (chess and go); changes in learning paradigms since 1950, etc.

Establishment of these periods and key facts of AI formation and technological development is not absolute, universal, and reasonable. Analysing and comparing the criteria of these separate periodization's only allows us to see the complexity of the processes of AI technology development and the factors that have influenced them for the better part of a century. From the stage of mass introduction of intelligent agents (2011) to the widespread introduction of AI in all spheres of social life (2018), we can

highlight the significant intensification of the period, where more technological breakthroughs occur in 1 year than in the previous several decades.

3. A four-stage periodization of AI development: early stage, lull period, AI renaissance, and the era of AI in the new millennium. Each of these stages has its own peculiarities and is accompanied by unique achievements and progress.

1943-1955 — is **the early period of AI development**. It is associated with the emergence and research of the first artificial neural networks that simulated the nervous system *(McCulloch-Pitts model, 1943)* and the development of Alan Turing's test (1950) to determine machine intelligence, which showed the possibility of modelling neural activity.

1956-1980 — is **a period of calm**. The theoretical basis for further research was formed, namely the emergence of the idea of expert systems - logical systems based on formal rules and knowledge bases. In the initial period of AI development, there were high expectations for the rapid achievement of full-fledged artificial intelligence. However, the realization of these expectations turned out to be much more difficult than anticipated. Limited computational and financial resources were one of the reasons for the protracted period of AI development (known as the first and second "Winter of AI"). At that time, computers had limited processing power and memory capacity. This made it difficult to solve complex problems and required additional resources for AI research.

1980-2000 — the period of AI revival. During this period, machine learning methods, neural networks, and expert systems were actively used. The main achievements include the development of deep neural networks that became the basis for image processing, speech recognition, and text processing models. These first natural language processing programs were very far from modern systems, but the field of algorithm optimization - research aimed at improving methods for solving AI problems - was formed.

2000 to the present is the **AI era of the new millennium**. Artificial intelligence has become an integral part of our daily lives. The application of AI has spread to many industries, including automotive, medical, financial, and legal. This period has seen an explosive growth in data and computing power, which has enabled the application of deep learning methods and the development of autonomous systems. Each of these stages emphasizes the constant progress of AI and its increasing role in the modern world *(Yashchenko, 2024).*

In the fourth stage, we can distinguish two stages of AI development.

2011 - 2015 — the **stage of deep learning and big data**. The use of terabytes of data to study and improve artificial intelligence models led to the integration of AI with Internet of Things devices, which led to the development of smart homes, smart cities, and control systems. Autonomous systems, robots and autonomous vehicles equipped with artificial intelligence have become a reality. The use of AI in augmented and virtual reality (AR) has opened new opportunities in education, medicine, entertainment, healthcare, and the entertainment industry.

2016 - 2024 — the **stage of large language models** ("AI Spring"). The beginning of this stage is associated with the founding of OpenAI in 2016-2017. 2018

— the emergence of a language model for natural language processing GPT (Generative Pre-trained Transformer) is a deep learning model that can generate the next word or phrase on based on the previous context. Models for converting a text query into a DALL-E image (2021), as well as speech synthesis.

The study of AI development periods in different sources may have different periods and stages depending on the expectation cycle (a concept developed by the technology and innovation research company Gartner Group). The expectations cycle starts from the moment a technological trigger appears - a new technology - to the formation of public expectations, testing, identification of shortcomings, loss of public interest in the innovation, elimination of shortcomings and mass commercialization, and ends with the perception of technology as an integral part of everyday life *(Fenn, 1995)*.

With this understanding, we will analyse the periods of digital transformation in Ukraine by the criterion of the adoption of regulatory frameworks for a particular sector. At the same time, we also realize that legal support appears much later than the emergence of relevant technologies. Therefore, to form a unified approach to the beginning and end of the relevant period, we will analyse how the subjects of legal regulation of technologies have changed at the state and public levels.

In analysing the legal support of the ICT sector in Ukraine, we will terminologically distinguish three definitions: informatization, digitalization, and digital transformation.

Informatization is a set of organizational, legal, political, socio-economic, scientific, technical, and technological processes for the development of digital technologies *(On the National Informatization Program, 2022)*.

Digitalization is the saturation of the physical world with specific ICT solutions, devices, and tools that ensure interaction in the information environment to meet personal, public, and state interests (*Concept of Development of the Digital Economy and Society of Ukraine for 2018-2020, 2018)*.

Digital transformation — is an independent process or a process within the framework of social transformation that takes place on the basis of the maximum use of digital technologies, such as Internet technologies, the Internet of Things, Industry 4.0, artificial intelligence, robotics, big data processing, cloud computing and others in order to increase the efficiency of group and individual activities of the human community *(Baranov and oth, 2024, p. 32)*

According to the regulatory and legal support of these processes, the periods of informatization, digitalization and digital transformation in Ukraine can be presented in the following order:

1991 - 2000 — the period of informatization, characterized by the creation of national information systems, development of telecommunications infrastructure, digitization of documents and transition to electronic mail systems (On the National Program of Informatization, 1998).

2000 - 2019 — the period of digitalization, characterized by the transition from analog to digital technologies, which allows not only storing information but also integrating it into unified systems for process automation (since 2005, electronic

document management systems have been actively implemented in government agencies, 2013 - the beginning of the massive use of digital technologies in public services, such as the Prozoro system for public procurement).

2019 and up to now — the period of digital transformation, characterized by profound changes in all spheres of society, changes in business and operational processes, and new ways of interaction between entities and technologies.

Informatization and digitalization can be viewed as preliminary, technical stages in which the technical infrastructure for working with data is built, while digital transformation is a strategic process that covers a complete restructuring of activities and processes by realizing the potential of digital technologies.

This is a general characteristic of the periods of informatization, digitalization, and digital transformation. For each industry in these periods, key stages and events can be identified that are associated with the emergence of new ways of realizing social relations. Based on this periodization, we will distinguish several stages for the legal industry, considering the introduction of various technological solutions that ensured the implementation of legal work.

Since 1998 - the stage of formation of the system of national information resources. Adoption of the National Program of Informatization to create a nationwide network of information support. Such informatization tasks were formed in 1998 *(On the National Informatization Program, 1998)*. In 2022, a new law on the National Informatization Program was adopted, which defined the following tasks: development, implementation and application of information and communication technologies in public administration, local self-government and public life; development of e-government and e-democracy; improvement of the procedure for providing public (electronic public) services; organization of information interaction between state bodies and *(On the National Informatization Program, 2022)*.

Since 2001, the stage of access to legal information has been in progress. Let's trace the development of state information resources of the legislative, executive and judicial branches of government in chronological order.

This stage is characterized by the emergence of specialized databases, such as Legislation, which contains current versions of legal acts, with the ability to view the texts of previous and future versions of laws and track all lawmaking work. The consolidation of separate information websites of the legislative *(Regulation on the Website of the Verkhovna Rada of Ukraine in the Global Information Network Internet, 2001)*, executive (*Procedure for Publication of Information on the Activities of Executive Bodies on the Internet, 2002)*, and judicial branches of power *(On Organizational Support for the Functioning of the Web Portal "Judicial Authority of Ukraine", 2014*), which were mostly information stands on the Internet for obtaining information, into multifunctional single web portals with the possibility of information interaction (submission of requests, information and generation of receipts on required payments). Electronic registries are emerging and being improved to allow for data verification.

The emergence of these databases and their technological development (adding search functions and filters) simplifies the process of finding legal information.

Since 2015, the e-governance stage has been characterized by the introduction of digital technologies in management processes and interaction between citizens and the state, and processes such as e-Government, e-Services, e-Commerce, e-Democracy, and open data are actively developing.

Since 2019, the stage of service delivery automation has been underway. For all Ukrainians, the most tangible service of this period is the emergence of the DIIA-portal, which allows them to receive electronic services *(Issues of the Unified State Web Portal of Electronic Services and the Register of Administrative Services, 2019)*. At the initial stage, the portal only had information on the required documents and authorities, and the timeframe for providing the service, as well as information on the cost or free of charge. Subsequently, forms of the required documents and the possibility of submitting them with a qualified electronic signature without physically visiting the Centres for Administrative Services or other public authorities were added. This stage is characterized by two-way information interaction between the government and the citizen.

Since 2022, the stage of automatic receipt of services has included the automation of "complex services" that require a change in the status of a citizen in unified state registers, for example, the registration action in the automatic mode of state registration of an individual as an entrepreneur without the participation of a state registrar *(On State Registration of Legal Entities, Individual Entrepreneurs and Public Organizations, 2024, Article 25-1)*. This process has radically changed the procedure and the subjective composition of participants, on the one hand simplifying operational decisions, and on the other hand posing a serious challenge to the legal system *(Baranov and Dubniak, 2023)*. In the future, many more such services will appear, considering the legislative innovation that requires administrative bodies to take measures to consider cases automatically *(On Administrative Procedure, 2023)*.

The stage of application of artificial intelligence technologies (from 2011, the private sector, from 2020 - certain areas of the legal profession in Ukraine, from 2024 - public services).

In the private sector, the widespread use of various devices began in 2011 (the massive introduction of voice assistants with speech recognition functions, such as Siri from Apple, Alexa from the retail giant Amazon). This stage is characterized by the addition of artificial intelligence technologies to registries and databases with legal information. The peculiarity of such software solutions is their commercial nature (paid subscription for the use of services) and the ability to obtain predictive analytics. For example, the addition of artificial intelligence technology to the registers of court decisions allows for predictive analytics, i.e., the likelihood of a particular decision being made by a particular judge within a certain category of cases. Such a forecast is made based on the analysis of the texts of decisions of a particular judge in a particular category of cases. By filling in the search parameters

in the program (available evidence in the case, specific circumstances, the period of the relationship and the decision, etc.), artificial intelligence technologies can provide the probability of a positive or negative decision in a matter of minutes, as well as an analysis of the client's specific situation. For comparison, with open databases of court decisions, a lawyer can also analyse a dozen cases and make an approximate forecast for the client regarding the decision. However, such a service can take, depending on the complexity of the case, from several hours to several weeks due to the significant amount of data that must be analysed by a human.

AI technologies are also used to analyse contractual provisions. In one experiment, when analysing the text of a 300-page contract, artificial intelligence produced an analysis with an accuracy of 94% in 26 seconds. A team of 20 lawyers analysed the same contract in 1 hour and 32 minutes, with an accuracy of 85% (*Artificiallawyer, 2018)*.

Since 2020, the use of AI in the legal profession in Ukraine has gained wide scientific popularity among legal scholars. The problems of using artificial intelligence in the field of intellectual property, including the protection of objects created by AI and the patenting of inventions, have been studied *(Dubniak, 2019)*. In the judicial and law enforcement systems, the problem of predicting a criminal's recidivism when a judge decides *(Borchevska, 2023)*, and the use of AI to prevent crime *(Buhera, 2021)*, the introduction of AI in judicial proceedings *(Udovenko, 2023)* and the notary process *(Karamza, 2021)*.

Since 2024, Ukraine has created legal grounds for the **use of artificial intelligence technologies when using the functionality of the DIIA portal** *(Issues of the Unified State Web Portal of Electronic Services and the Register of Administrative Services, 2024).*

The stages of development of information technology in law are listed to illustrate the areas that can be automated, which, on the one hand, simplifies and speeds up the process of providing legal services. On the other hand, it should demonstrate that not every technological solution is the result of the use of artificial intelligence. Currently, in most cases, these are examples of simple or complex automation of certain tasks and services.

Conclusions.

1. The development of AI is characterized by complex dynamics, which is reflected in different periodization's. The periods are based on technological breakthroughs, levels of financial support, and public expectations. From the ideological formation to the mass adoption of AI, the progress of this industry is uneven and cyclical.

Each periodization depends on the chosen criterion: funding, technical breakthroughs, changes in public expectations, or legal regulation. This approach shows the complexity of the interaction between society, technology, and legal instruments.

2. Since 2011, there has been a rapid acceleration in the pace of development, with more breakthroughs in a year than in the previous few decades. This reflects

new approaches to AI training (deep learning, transformational architectures, large language models).

3. Given the heterogeneous approaches to periodizing the development of AI technologies in the world, we have identified three periods of digital transformation in Ukraine

- Informatization (1991-2000) - infrastructure development.

- Digitalization (2000-2019) - the introduction of ICT in public administration and services.

- Digital transformation (2019 - present) - strategic changes in all spheres of public life due to AI and other technologies.

4. When studying the legal regulation of the introduction of new technologies in the public sector, we found a significant time lag from the moment of new technologies before their actual widespread use, which creates challenges for the integration of innovations into the legal framework. In fact, legalization occurs after the technologies are widely used. In our opinion, given the identification of legal problems, their resolution by the law could have been done earlier.

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INITIATIVE BUDGET AS A TECHNOLOGY OF LOCAL SELF-GOVERNMENT

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Abstract:

The initiative budget is one of the important tools of modern local self-government, which allows citizens to directly influence the processes of formation and usage of local budget funds. The study focuses on analyzing the role and significance of budget initiatives in the development of democracy, increasing transparency and efficiency of management at the local level. The study examines the main stages of implementing budget initiatives, their advantages and challenges, and also proposes recommendations for improving this mechanism in the context of modern economic and social changes.

Introduction:

Local self-government is the basis of democratic processes in Ukraine. In the context of modern transformations and the need to improve local governance, new mechanisms for involving citizens in decision-making at the local level are especially important. One of such mechanisms is the initiative budget, which allows citizens to directly influence the process of forming the local budget and implementing projects that meet their needs. The public initiative budget originated at the end of the 20th century in the Brazilian city of Porto Alegre and has since gained popularity in many countries around the world. The main idea is that part of the budget is allocated for the implementation of projects proposed by community residents, and the final decision on their implementation is made through voting [1]. We believe that this process increases budget transparency, allowing local authorities to directly address the needs and desires of community residents.

According to the concept of democratic budgeting, budget initiatives not only improve the management of budget funds, but also stimulate citizen activity, which contributes to strengthening social cohesion and the development of civil society. The process of involving residents in determining the directions of using budget funds for the implementation of their projects is a vivid example of the direct application of democratic principles. The main goal of the initiative budget is to integrate residents into the discussion and solution of problems that arise in their community. A study of the scientific literature has shown that the initiative budget is an effective approach to budget formation, which involves the active participation of citizens in determining priority areas and distributing funds. Scientists believe that the essence of this approach is to provide citizens with the opportunity to actively influence decision-making regarding the expenditure of budget funds, whether at the state or local level. Citizens can submit their own ideas and projects, which, if approved, can be financed from the budget [2].

At the same time, the initiative budget may include various tools, such as public discussions, consultations, voting and other mechanisms. These tools are key elements that ensure the effective implementation of this democratic process in local financial management. They cover a wide range of methods, technologies and procedures that promote the active involvement of citizens in making decisions on the allocation of budget funds.

Implementation of the initiative budget involves a sequence of stages [2; 3]:

✓ the first stage is the organization of the process of collecting proposals and initiatives from citizens regarding projects that should be financed from the local budget. This can be done through online platforms, surveys, public hearings or other forms of feedback;

✓ after collecting proposals, local governments proceed to the second stage. In close cooperation with public organizations or special commissions, they evaluate and select initiatives. Accordingly, they assess the feasibility and realism of projects. Financial constraints and social needs of the community are also taken into account;

✓ the most important is the third stage, which involves voting for projects and their subsequent approval, in which all citizens can participate. This allows you to directly influence the distribution of budget funds and contributes to the development of local democracy.

✓ at the last, fourth stage, project implementation takes place. After the approval of projects, local government bodies organize their implementation. An important component of this stage is monitoring and evaluation of project implementation.

The public budgeting process is a complex but important component of democratic governance, ensuring the active participation of citizens in making decisions on the distribution of budget funds. The cyclical nature of this process allows for constant improvement of its effectiveness, taking into account feedback and the results of previous stages. Each stage is important for achieving the final result - transparent, effective and fair distribution of resources, in accordance with the needs of the community [3; 4].

The benefits of budget initiatives are evident in a number of aspects, from improving governance efficiency to strengthening social cohesion. First, one of the main advantages of budget initiatives is that they contribute to increased civic engagement. When people can directly participate in deciding how the local budget will be spent, this creates a sense of personal responsibility for community development. Citizens become not only consumers of services, but also active participants in governance processes, which contributes to the formation of a democratic culture at the local level.

Secondly, the introduction of the initiative budget significantly increases the transparency of local finances. When the community participates in determining spending priorities, local authorities are forced to clearly justify their decisions and explain why some projects receive funding and others do not. This reduces the opportunities for abuse and corruption, as the process becomes more open and accountable to the community.

Thirdly, initiatives proposed by citizens themselves are often aimed at improving social infrastructure. They allow solving specific problems that directly affect the quality of life of residents. Such initiatives, as a rule, respond to the real needs of the local community, rather than abstract state programs, which makes services more user-oriented.

Fourth, budget initiatives can significantly strengthen social cohesion in a community. When residents work together on ideas that affect their environment, this helps to strengthen ties between people, increase their sense of unity and shared responsibility.

However, despite the numerous advantages, the implementation of such a mechanism faces a number of challenges that can reduce its effectiveness or complicate the implementation process [3; 4]:

✓ funding restrictions, negatively affecting the number of funded projects. This can lead to competition between projects and dissatisfaction among part of the community;

✓ low participation of citizens in the process of submitting and voting for initiatives can limit the effectiveness of this technology;

✓ there is a risk of manipulation of the voting results by local authorities, when certain projects receive support due to administrative pressure or unfair practices.

To overcome these barriers, it is necessary to improve the organizational and legal framework, increase the digital literacy of citizens, and ensure transparency and fairness in decision-making processes. Solving these problems will allow realizing the potential of budget initiatives and contribute to their effectiveness in the development of local communities.

Conclusion:

Budget initiatives are an important step towards the development of democratic governance at the local level. They contribute to improving transparency, accountability, and efficiency in spending budget funds. At the same time, they create opportunities for active participation of citizens in resolving issues that directly affect their daily lives. The implementation of budget initiatives is an important step towards the development of democratic governance at the local level, but in order for this mechanism to become as effective as possible, it is necessary to take into account modern economic and social challenges. Increasing civic engagement, improving information accessibility, improving the project selection system, involving youth, and ensuring financial stability are just a few recommendations that can help realize the potential of budget initiatives in practice.

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THEORETICAL PRINCIPLES OF APPLICATION OF INFORMATION AND COMMUNICATION TECHNOLOGIES IN PUBLIC ADMINISTRATION

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Abstract. The paper examines the concept of modern electronic governance, its relationship with other concepts based on theoretical approaches, legislation and international agreements. The possibilities and features of using ICT in the implementation of the principles of good governance, taking into account Ukrainian legislation and practice, have been determined. The dynamics of the implementation of electronic services at different levels of government in Ukraine are considered and directions for further development are indicated. The principles of building an electronic management system for the purpose of combating corruption have been systematized. Analysis of international agreements in the field of e-government and the importance of additional information tools for their formation was emphasized. The mechanism, subjects and features of the provision of administrative services through the Diya Portal and other online and offline services were determined. The possibilities of using open data in various relations, including the fight against corruption, and their characteristics were also highlighted. It was also noted the need to structure administrative services according to industries and forms of their provision.

Introduction.

The application of information and communication technologies in the field of public administration and the development of the electronic government system give rise to important questions regarding compliance with the norms of administrative law during electronic interaction between subjects of administration, individuals and legal entities. The concept of information technology was incorporated into the communication process in the 1980s and now includes hardware such as computers and servers as well as software such as operating systems and network protocols. These possibilities are widely used in the educational process, which makes ICT a pedagogical technology. Modern legal innovations in the field of ICT implementation in the practice of public administration, development of the e-government system and related aspects of the use of the latest electronic technologies, software products and information protection in computer networks used by authorities are presented by scientific developments. In the doctoral dissertation of B.A. Kormych ("Organizational and legal foundations of the information security policy of Ukraine", 2004) for the first time in Ukrainian legal science justified the existence of specific legal relations arising in the information sphere, and developed the concept of the formation of the field of information law. The study indicates that the circulation of information takes

place with the help of special technical means and technologies, which become one of the most important components of information processes and require an appropriate level of security and legal regulation of their functioning [1]. In the dissertation of A.M. Shkolyk, who was awarded the degree of Doctor of Philosophy in the field of jurisprudence for the work "Administrative-procedural legislation in Ukraine: formation and systematization" (2021), indicated updated trends in the improvement of acts of administrative-procedural legislation, including the maximum simplification of administrative proceedings and its transition mainly to an electronic format [2]. Smirnova N.R. (2023) worked on the implementation of administrative and legal norms through information and communication technologies in the field of public administration with the aim of creating a theoretical basis for an effective e-government system in Ukraine [3]. Without diminishing the importance of scientific works, there is a need to develop new approaches to the conceptual foundations of the implementation of administrative and legal norms through ICT, which causes gaps in the organizational support for the formation of an effective model of e-government in Ukraine.

The development of the Internet and ICT is happening at an incredibly fast pace, which can be surprising. This is due not only to the development of society's information culture, but also to rapid progress in the field of modern electronic technologies. The Internet has become a tool that allows a person to choose sources of information, independently evaluate their reliability, objectivity and usefulness, and also use this information for business and entertainment. At the same time, the variety of available sources of information is growing. Nowadays, the information culture of many people is being changed by the influence of social and other computer networks. Platforms such as Twitter or Facebook increasingly influence people's daily lives, offering new ways of communication and having a significant impact on the distribution of information, making them a vivid example of modern mass media. Ensuring the information security of citizens and the ability of the government of any country to create a healthy environment with the help of the latest information tools are important aspects of a modern democratic society. At the same time, information and communication technologies must comply with the current legislation and prevent its violations, ensuring the correct administration of public services. This is a necessary basis for creating a system of electronic management and effective work of state bodies.

The term "information technologies" includes methods, technical and software tools that form a technological chain for collecting, storing, processing and transmitting information [4]. These technologies went through different stages of development, similar to the stages that are known in the case of the railway or the telegraph, as defined by N.H. Carr: 1) initial installation (characterized by the high cost of the technology and creates a long-term market advantage for its owner); 2) active development in terms of quantitative and qualitative indicators; 3) general availability (the product becomes available at a low price, the technology becomes publicly available and necessary to maintain competitiveness, but no longer gives the owner advantages) [5]. Therefore, IT includes all the mentioned stages of

development when considering this issue in the context of the history of the development of the information society. However, the most important thing is that IT provides advantages in the field where it is used, because it accelerates the processes of exchanging information in extraordinary volumes.

The scientific literature emphasizes that the concept of e-government involves the integration of information resources of state authorities, providing access to them, as well as the development of a system of online services, including paid ones, with the main goal of establishing direct and interactive communication between citizens and government institutions via the Internet . It is necessary that the information network infrastructure is aimed at solving the current political, economic and social tasks of the state. It should ensure citizens' access to open state information, disseminate objective and reliable information about the activities of authorities, which strengthens trust in the state and its policies. In addition, it is important to ensure a constant dialogue between the state, citizens and public institutions, as well as to establish the necessary level of public control over the activities of state bodies and organizations. unification of information resources and services of state authorities and local self-government with the aim of creating a single national information space; improvement of the state administration system by optimizing the structure of the state apparatus and reducing financial costs; phased transfer of part of the paid public services to the system of public network services that meet the needs of citizens and organizations, effective support of the economic activities of public entities, engaged in economic activity, allowing them to effectively integrate into the national and global economic space; interaction and cooperation with state bodies of foreign countries and international non-governmental organizations.

Through the gradual introduction of ICT into everyday work, public administration bodies got closer to their main consumers of services, created convenient conditions for simplifying communication and to a large extent got rid of the human factor, which does not always have a positive effect on the process of realizing the rights and duties of citizens. Today, the concept of e-government can no longer be considered only as a new technology, as it has become an effective tool for restructuring the system based on bureaucracy. The export of online services involves the implementation of organizational and internal changes in public administration structures aimed at meeting the needs of citizens (G2C) and businesses (G2B). It also means integration of services and horizontal interaction between government structures (G2G).

When studying the evolution of the concept of e-government, it is impossible not to take into account the concept of Open Government (hereinafter - OG). It is not new and in a broad sense it involves a state management system, such as e-democracy, and is aimed at broad involvement of the country's citizens in solving socially important problems and making decisions. In recent decades, countries around the world have been implementing OG initiatives as a way to increase transparency, establish G2E connectivity, fight corruption, and promote economic development.

Implementation of e-government in Ukraine since the mid-2000s. was accompanied by an update of legislation in the field of ICT use. Yes, the Decree of the President of Ukraine dated October 20, 2005 was issued. No. 1497/2005 "On priority tasks regarding the implementation of the latest information technologies", Order of the State Committee for Communication and Informatization dated August 15, 2003. No. 149 "On approval of the List and Procedure for the provision of information and other services using the electronic information system "Electronic Government"" and a number of other legal acts identified e-governance as one of the top priorities of public administration reform. The main directions of development in this area have become: digitalization (digitization), digital transformation, international and state-legal integration, ensuring information security, information sovereignty. At the same time, the organizational and legal mechanisms for the development of the electronic format of the activities of state bodies are the mechanisms developed within the framework of the following state programs: State strategy of regional development for 2021–2027. The participation of citizens in policy-making and their subsequent participation is important for civil society, especially in the initial stages. Citizen engagement becomes a value with the development of Information and Communication Technologies (ICT), as simplified feedback creates the conditions for electronic participation.

Public authorities, involving the public in the creation of public policy, deepen the process of political democratization of society, accelerate the establishment of a social and legal state, and form the legal independence of a person from the state. According to the idea that public information is intended for all citizens and should be accessible, it is important for governments to create mechanisms to implement this idea, although very often they lack the capacity to create such mechanisms. The way out of this situation can be G2B interaction, where private entities can act as stakeholders or develop open data with the aim of turning it into a source of income. Companies can also use this data to create services, so the role of open data in today's society becomes apparent, and this goes beyond the usual transparency offered in theory.

As a model of government reform, OG is gaining popularity every year. But, just as in theory, where each researcher evaluates opportunities and prospects 29 subjectively, so in practice the reform is built according to different views and with an emphasis on certain aspects, which is related to the material capabilities of each country and the level of information development society. At its core, e-governance contains confirmation of the prospect of the technological possibilities of the information society for the evolution of state governance models. I. Abu-Shahab singles out six factors for evaluating the use of information: intention to use, availability of information, quality of information, accountability, cooperation and acquisition of competence. The prospect of using ICT is determined by how useful the information is and the possibility of its use. The interrelationship of these factors is embodied in the production model, where, subject to the availability of access to information and its usefulness, the interaction between the subject possessing the information and the consumer will be established [6].

Conclusions.

So, e-government in its theoretical and practical implementation is a trend of developing countries all over the world. It covers various manifestations of electronic managerial (administrative) activity provided by ICT: e-government, e-democracy, etc. Digitization of the life of a certain country and the possibility for citizens and business entities to receive all state or local management services indicates the introduction of e-government in this country. From the political and technical side, the concept is objectively based on the use of ICT and other opportunities of modern society. That is why global (transnational) and local initiatives play an extremely important role in the development of a modern information society and the construction of a democratic state. The presence of differences in potentials, mentalities and economic factors are catalysts for change. The ability to use the experience already gained helps to focus on what needs to be achieved, and not on what difficulties will arise on the way. The modern world is connected by technologies that unite society, open it up and give impetus to movement.

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THE ARTIFICIAL INTELLIGENCE IMPACT ON COMMUNITY RECONSTRUCTION

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Abstract. Ukraine, which suffered from large-scale destruction as a result of the war, is facing the challenge of post-war reconstruction. For this process, the effective use of limited resources is important, where artificial intelligence (AI) can play a key role. We have examined the role of artificial intelligence (AI) in the post-war reconstruction of Ukraine. The main areas of its application include infrastructure reconstruction, development of the agricultural sector, medicine, education and environmental protection. AI contributes to the automation of processes, optimization of resources and acceleration of community recovery.

Introduction:

The emphasis is on the need to combine technologies with human potential, as the successful implementation of AI depends on the qualifications of specialists and regulatory regulation. AI can become an important tool for modernization, creating a model of sustainable development that will serve as an example for other countries.

Ukraine is on the verge of huge changes. After a year of full-scale invasion, the country continues to face large-scale destruction. By 2024, the damage caused to Ukraine's infrastructure reached 155 billion US dollars. The world has not seen such a scale of destruction since World War II.

Ukraine's post-war reconstruction will require enormous resources, which are always limited. Therefore, automating routine processes becomes extremely important, because human participation can be minimized. Artificial intelligence (AI) can play a key role in this task, as its technologies allow you to quickly analyse huge amounts of data and make accurate forecasts based on existing knowledge.

The use of AI in community recovery is relevant due to the need for quick and effective solutions for rebuilding infrastructure and socio-economic life. Innovative approaches allow optimizing processes, increasing safety, and improving the quality of citizens' lives. The AI use can become an example for other countries facing similar challenges and contribute to the overall development of a technological society [2].

The main areas of AI use in community restoration are shown in Figure 1.

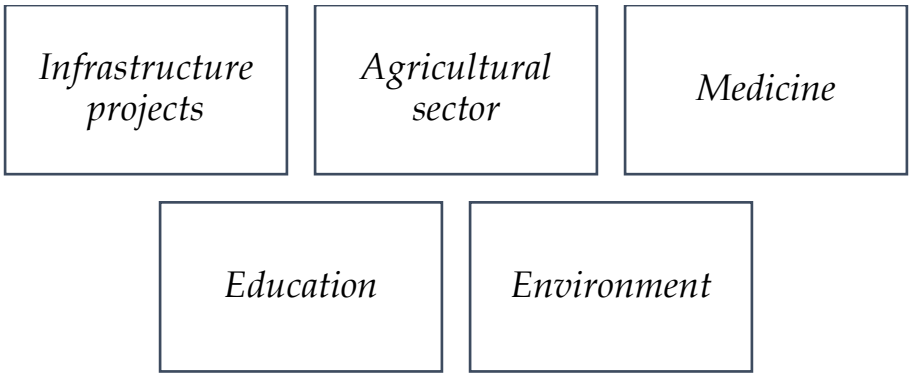

Fig. 1. *Main areas of using AI in community recovery*

Let's take a closer look at each of the main areas of use of AI in community restoration:

1. Infrastructure projects.

1.1. Planning for the restoration of destroyed buildings. Imagine a solution that receives drone footage of a destroyed building and provides a detailed analysis of the possibility of reconstruction. AI can plan material costs, create estimates, and calculate construction time. Automation of construction processes helps manage projects and optimize planning and resource management, which reduces delays and increases efficiency.

1.2. Damage assessment. A project by the Polish-American company Tensorflight demonstrates how AI can assess damage by analysing satellite images. This automates the damage assessment process, reducing the cost and time of inspections. An online waste assessment calculator also helps plan costs for dismantling, logistics, and waste storage.

1.3. *Master planning of destroyed cities.* AI can change the approach to urban planning, creating environmentally friendly, comfortable cities according to world standards. The technologies allow to draw up a plan for a settlement based on criteria and best construction practices. "Digital twins" - exact copies of physical objects in the virtual world - facilitate planning and the involvement of specialists.

1.4. Retraining. AI technologies help create knowledge bases for various professions, facilitating the retraining of designers, architects, surveyors and engineers. Virtual teachers help combine practice with theory, accelerating the learning and adaptation process of new specialists.

1.5. Augmented reality technologies for education. Augmented reality technologies are used in high-tech factories to create three-dimensional models of objects. This can also be applied in construction, where in augmented reality you can see a finished house with all floors and materials, which opens up almost limitless opportunities for education and reconstruction planning.

1.6. Worker Safety. Computer vision and AI ensure worker safety in the workplace. Sensors read worker movements and warn of potential hazards, reducing risks and increasing workplace safety.

2. *Agricultural sector.* AI helps analyse crop areas, black soil quality, and land restoration opportunities. Drones, satellites, and AI-powered sensors monitor plant health and soil quality. This allows for production planning, resource optimization, and meeting global demand for products.

3. *Medicine.* AI helps reduce patient admission times by automating medical record keeping. For example, the DeepScribe system uses AI to automate doctors' record-keeping. AI is also helping in surgery, using robotic instruments to improve surgical procedures, as well as in creating intelligent prosthetics that adapt to the user's movements.

4. *Education.* AI helps personalize the learning process by creating individualized lesson plans. For example, the NolejAI platform allows teachers to quickly create interactive lessons and teaching materials based on uploaded content.

5. *Environment.* As a result of the war, the environmental situation in Ukraine has become more complicated. AI can aggregate data on the quality of water, soil, and air and determine priorities for cleaning and demining territories. This allows for more efficient use of resources for environmental restoration [1].

Following the key areas where artificial intelligence can be useful for community recovery, it is also important to recognise that technologies alone is not a complete solution. They bring significant benefits, but they also come with certain risks and challenges.

Technologies will play an important role in the country's recovery, but it is not a panacea. The implementation of AI is accompanied by risks: issues of ethics and transparency of algorithms, protection of personal data, possible errors in systems and their consequences, dependence on technologies and its vulnerability to cyberattacks. The effectiveness of the use of technologies and minimization of risks depend on the qualifications of specialists. Therefore, the main resource remains people: engineers, scientists, and managers.

Ukraine needs a comprehensive recovery strategy that includes human resource development. Technologies can streamline processes in many areas, from construction to agriculture. Rebuilding the country is an opportunity to modernize existing systems, sectors, and industries. By bringing together talent and technological innovation, we can create a model of sustainable development that will serve as an example to the world. The experience gained during recovery can become a catalyst for the export of knowledge and practical skills [3].

Conclusions:

Therefore, artificial intelligence is a powerful tool for community recovery, capable of optimizing reconstruction processes and effectively using limited resources. For the successful implementation of AI, it is necessary to ensure a balance between technological capabilities and human expertise, create a regulatory framework and train qualified specialists. An integrated community recovery management system, where AI is an auxiliary tool for decision-making, can be the key to success.

Ukraine has a unique opportunity not only to rebuild what was destroyed, but also to create a model of sustainable community development using the latest

technologies, which will become an example for the world. The expertise gained during the reconstruction can become a powerful accelerator for the export of experience and knowledge. AI can significantly contribute to this process, but to achieve success it is necessary to ensure a competent combination of technological solutions and human skill.

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GENDER APPROACH IN THE MANAGEMENT OF A TERRITORIAL COMMUNITY

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Abstract. The article explores the implementation of gender-oriented governance at the level of territorial communities in Ukraine in the context of ensuring equal rights and opportunities for men and women. It examines the theoretical foundations of the gender approach, its transformational potential in overcoming structural barriers and inequalities, as well as the practical aspects of integrating this approach into the activities of local self-government bodies. The role of gender statistics, community profiling, gender analysis, and other tools in shaping effective gender equality policies is analyzed. Attention is drawn to the importance of the position of a gender policy coordinator, advisory and consultative bodies, and the involvement of residents in decision-making. Examples of successful practices in implementing the gender approach, which contribute to sustainable community development and inclusiveness, are presented. Special attention is paid to the integration of the gender-transformative approach in accordance with international standards and UN recommendations.

Introduction. Ukraine is progressing in the sphere of gender equality on par with the EU. Over the years, the country has set a high standard for implementing gender equality policies. Today, when it comes to recovery, green transformation, developing Euro-integration potential, and shaping the Ukraine-NATO program, gender policy and inclusivity are cross-cutting priorities at all levels of governance. Achieving equal rights and opportunities at the local level is impossible without incorporating the gender approach into the governance practices and policies of local self-government bodies.

The gender approach goes beyond merely balanced representation of men and women in government structures and local councils. It also involves implementing gender-sensitive management practices, reforming existing policies, and introducing specialized policies and programs.

Gender-oriented governance refers to the decision-making and implementation process across all levels of governance, involving measures, attitudes, and practices of various stakeholders aimed at ensuring gender equality and social justice [1].

The gender approach helps identify the needs of women and men and/or their respective groups, ensuring equal access to public goods. Gender equality spans all areas of life: political, economic, cultural, and social development. Accordingly, issues of equality and non-discrimination are essential components of strategic and programmatic community documents [5].

The gender-transformative approach aims to eliminate gender inequality, remove structural barriers such as unequal roles and rights, and empower marginalized populations [6].

Gender-transformative approaches work to address gender inequality by transforming harmful gender norms, roles, and relationships while ensuring equitable redistribution of power, resources, and services. UNFPA identifies gender-transformative approaches as a key accelerator for achieving the outcomes of the 2022-2025 Strategic Plan [7].

The gender approach focuses on observing, analyzing, and transforming cultural, economic, and political differences that shape the conditions and status of men and women, boys and girls, causing inequality and arising in situations of discrimination and social isolation.

Tyurina D. [4], in her research, substantiates the multifaceted role of the state in shaping gender-balanced businesses and society as a whole. The author highlights the importance of gender balance in entrepreneurship, which encompasses a significant share of the economically active population, and justifies the role of public policy in creating conditions for gender equality. She identifies the main types of businesses in terms of gender balance and formulates key tasks for state regulation to support gender inclusivity in entrepreneurship. Indicators of gender balance are outlined, enabling the monitoring of progress and identifying barriers to equal opportunities for men and women in business.

Gender-transformative approaches (GTA) are programs and initiatives that create opportunities for individuals to actively challenge gender norms, encourage social and political influence for women within communities, and address power imbalances between genders. GTA fosters an enabling environment for gender transformation, moving beyond simply involving women as participants. It forms part of the continuum of gender integration, incorporating gender considerations into all aspects of program and policy conceptualization, development, implementation, and evaluation [7].

The gradual incorporation of this approach into public policy planning and management globally, and within the UN specifically, arises from the need to evaluate and value reality through the lens of fairness and equality. On one hand, this aims to mitigate potential adverse outcomes that leave men and women at a disadvantage—striving to avoid gender discrimination. On the other hand, it promotes equal opportunities for men and women by empowering them as rights-holders [8].

In practice, implementing the gender approach in communities involves creating equal conditions and opportunities for women and men to participate in community life, access its resources, and benefit from its services. Essentially, this represents the realization of gender equality policies. The concept of "gender equality" is defined in the Law of Ukraine "On Ensuring Equal Rights and Opportunities for Women and Men," which came into force in 2006. Integrating gender approaches into the activities of public authorities is a matter of social justice necessary for sustainable human development, as gender parity in representation is one of the fundamental hallmarks of a democratic society.

Back in 2018, to expand opportunities for leveraging the potential of women in amalgamated territorial communities, the DESPRO project launched a support program for women leaders in local self-governance. As part of the project, participants learned effective communication, developed teamwork skills, and studied the fundamentals of negotiation practices, with a particular focus on implementing changes at the local level. The workshops were highly successful: DESPRO received over 300 applications from women representatives of local self-government from all regions of Ukraine to participate in the 2019 workshop.

Based on efforts to formalize the sequential use of the gender approach, the Ministry of Social Policy of Ukraine issued an order approving the "Methodological Recommendations for Implementing the Gender Approach and the Human Rights-Based Approach at the Territorial Community Level" [2].

One of the initial analytical steps in applying the gender approach is collecting gender statistics (or gender-sensitive data). These accurate datasets reflect inequalities in the conditions and opportunities of men and women across different spheres of life. Gender statistics illustrate distributions by gender and other social characteristics such as age, marital status, disability, and its forms. At the community level, as well as in various government bodies and institutions, statistical data collection includes classifications by gender or other social attributes. The closer communities work with data, the better they understand where resources are needed and which initiatives should be funded.

In addition to collecting gender-sensitive data, a territorial community profile is developed to provide a detailed description of the needs of various population groups within the community. This enables the formulation of recommendations to improve service provision in alignment with those needs.

In practice, communities may develop similar analytical documents under different titles. For instance, these could be called social passports, gender passports, or community passports, among others. In such cases, it is beneficial to consolidate already collected data about community residents into a unified analytical product that presents these data and highlights trends over time.

Another tool for implementing gender-oriented governance is gender analysis. This helps identify gender gaps, account for gender aspects across various fields of activity, and incorporate a gender perspective into local budget programs, projects, policies, or the development of community strategic documents.

Gender-Oriented Governance can also involve establishing a position within the local self-governance structure responsible for ensuring gender equality at the local level. At the community level, such entities may include:

- Authorized Representative (Coordinator) for Gender Policy. This official is responsible for ensuring equal rights, coordinating projects and programs aimed at promoting gender equality in the community. The authorized representative may hold a specialized position or serve as a deputy head of the community.
- Consultative and Advisory Bodies. These are formally created groups established to collaboratively address issues related to equal rights and opportunities. They can also function as working groups, coordination committees,

expert panels, or public councils. These bodies may include local specialists from government agencies, advisors, gender policy experts, active residents, community organizations, and NGOs. Specific consultative and advisory bodies may be formed to address issues such as inclusivity in local governance or councils related to internally displaced persons.

- Gender Advisory Groups. These are associations of advisors focused on gender equality. Their work may include advocating for policy decisions, initiating projects, and adapting international and national gender legislation to the local level [1].

An essential requirement for achieving gender equality in governance is the representation of women and members of diverse social groups in leadership and elected bodies.

Another critical tool is engaging residents in decision-making processes to advance gender equality and inclusion. Particular attention should be given to involving and addressing the needs of those who wish to influence relevant decisions. Vulnerable social groups may have less access to information about political processes, less free time, or limited technical expertise on certain issues. Therefore, their inclusion requires special efforts, such as additional outreach and consideration of their needs when designing participation processes.

A valuable practice involves engaging external specialists in gender policy issues to provide expertise and consultancy services. External experts can be instrumental in collecting and analyzing gender statistics, developing analytical materials such as gender profiles, or offering advice on incorporating gender perspectives into local policies. This external input helps bring a fresh perspective to the local context and provides professional guidance to enhance gender-sensitive governance.

An important aspect of gender-oriented governance is not only the application of specific tools within the structure of government bodies but also the reform of practices for engaging with community residents. Gender sensitivity in the provision of public services aims to ensure equal access for men and women to services provided by local self-governance bodies.

Conclusions:

Gender equality and gender-oriented governance are key elements of sustainable development, contributing to social justice and effective management. In the current context of recovery and integration into the European community, Ukraine demonstrates significant progress in implementing the gender approach at both the national and local levels. The introduction of gender-sensitive practices into the activities of local self-governance bodies, the application of gender analysis, and the collection of gender-sensitive data ensure more balanced policies tailored to the real needs of communities.

The development of institutional mechanisms, such as the establishment of gender coordinator positions, advisory and consultative bodies, or gender advisory groups, creates favorable conditions for achieving gender equality at the local level. Gender-transformative approaches aim not only to remove structural barriers but also to redefine traditional roles and norms, fostering a progressive redistribution of power, resources, and services.

Training and support programs hold significant potential in helping female leaders in local self-government acquire new skills and successfully implement changes in their communities. Integrating the gender approach into community governance is not merely a matter of fairness but also a necessary condition for democratic development that considers the interests of all members of society.

Thus, the implementation of gender equality remains a vital priority in building resilient communities and ensuring the sustainable development of the country as a whole.

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NFT AND BLOCKCHAIN AS THE FOUNDATION OF THE METAVERSE ECONOMY

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Abstract. With Facebook officially changed its name to Meta in Oct. 2021, a new stage of digital revolution has begun, as the metaverse has become a new norm of social networks. Blockchain and NFTs, or non-fungible tokens, happened to be the cornerstones of the modern era. The thesis examines the influence of the two technologies on digital market. Key models such as Play-to-Earn and Create-to-Earn are analysed and their impact on virtual commerce is being highlighted. By reviewing the implementing modern ideas and of legal aspects, the thesis forms an idea of how the global economics would look like.

Introduction. Blockchain is a decentralized, distributed, and public digital ledger that stores transactions in a sequence of cryptographically linked blocks. It was created by a person (or group of people) using the name Satoshi Nakamoto in 2008 for the Bitcoin cryptocurrency. Blockchain technology is based on three key concepts, that are decentralization, cryptography and smart-contracts [1] [3].

NFTs, or non-fungible tokens, are unique digital assets that use blockchain technology for verification. They serve as the proof of owning certain virtual goods such as digital real estate, in-game assets, art pieces, collectibles and avatars. NFTs are based on smart-contracts, such as Ethereum, Solana and Polygon [2].

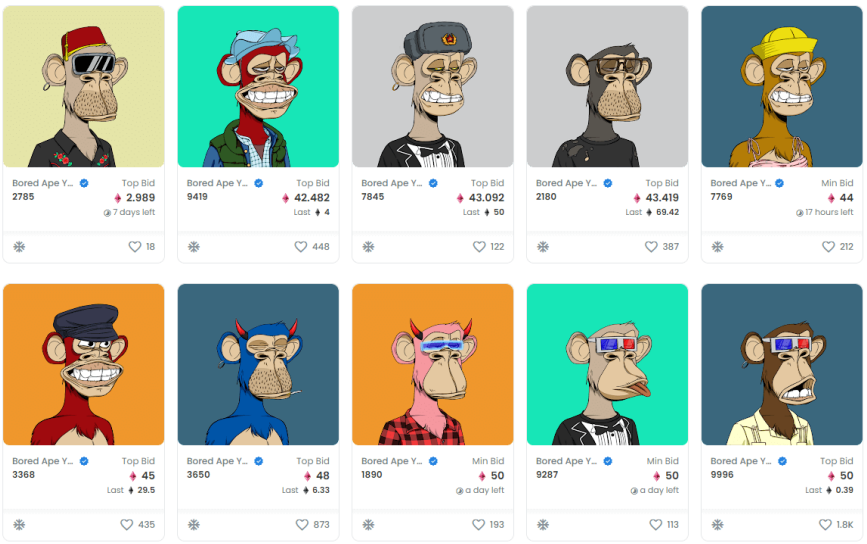

Fig. 1. *Examples of NFTs*

The metaverse economy includes transparency, security and decentralization, and is based on blockchain technology. Its main concepts are Play-to-Earn (P2E), that allows users to earn various rewards for participating, and Create-to-Earn (C2E), that rewards digital artists for creating content. Axie Infinity and Decentraland are platforms that allow users to trade, monetize, and engage with NFTs, and in such a way they demonstrate these concepts. Virtual worlds provide dozens of opportunities for monetization. Some of them are:

- Trading virtual goods.
- Selling, leasing, or hosting experiences on virtual real estates.
- Using NFTs as subscriptions for gaining access to special events.
- Using cryptocurrency or NFT fees for monetizing virtual events.

Metaverse economy connects both digital and physical marketplaces to redefine the industry and supply with job opportunities and entertainment options. The ideas develop and metaverse has all the potential to grow into a global economic environment [2] [3].

With NFTs gaining popularity in the metaverse, more and more legal issues have arisen. They vary from intellectual property rights to taxation, highlighting the importance of defining structures that are to regulate the difficulties. It is vital to preserve the sustainability and equity in the metaverse economy, as with the absence of proper regulation, the reputation of the system would be completely vanished.

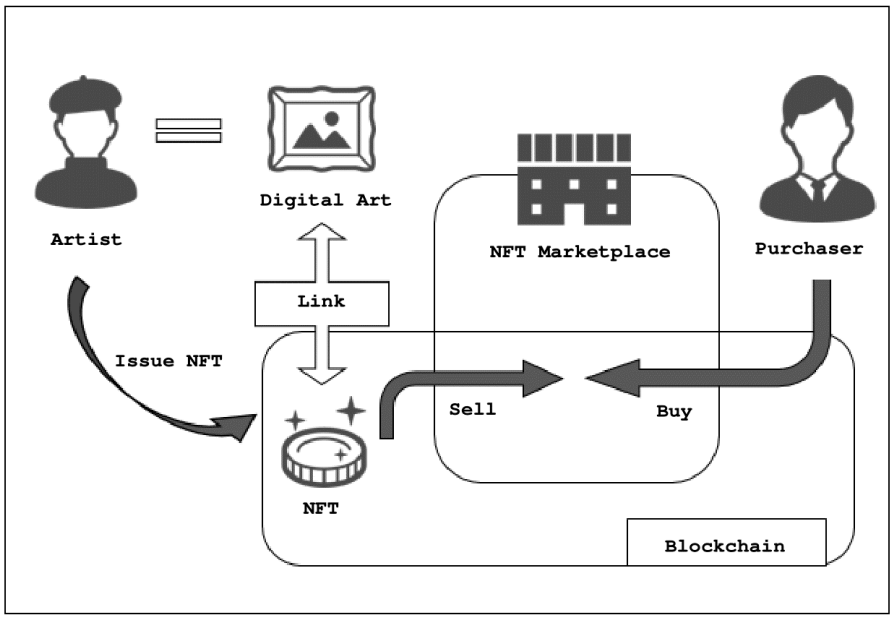

Fig. 2. *Mechanism of NFT transactions*

Both NFT purchasers and artists should stick to intellectual property rules as it is still unknown who has the right to own the NFT. There are NFT classifying concerns, whether they are assets, commodities, or digital goods. Moreover, taxes are also being discussed by the governments that are looking for an optimal solution to regulating the problem. The way blockchain transaction are committed might not

be regulated by the legal norms. It is necessary to protect customers that might experience fraudulent activities and deceptive marketing strategies. By implementing legal guidelines, the metaverse economy would be sustainable and trusted by many [4].

The rapid growth of the metaverse and NFTs has lefts its mark on global economics and digital interactions. Its future is predicted to be bright, as more and more ideas are being implemented nowadays. However, it is necessary to cope with all the legal, ethical, technical and environmental obstacles. NFTs would probably become the foundation to digital economics, including various daily life aspects [5].

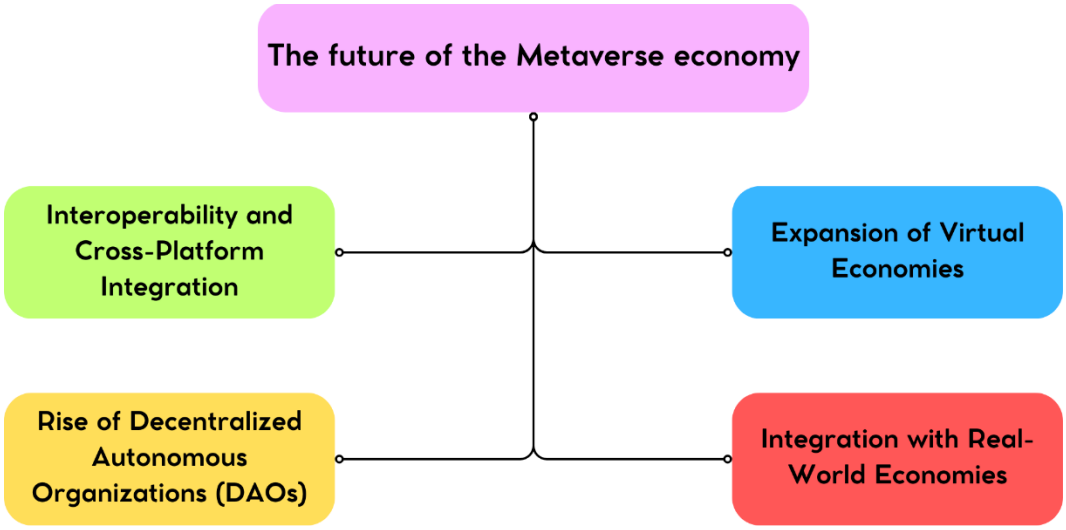

***Fig 3**. The future of the Metaverse economy*

Summary:

The thesis declares the ways in which blockchain and NFTs are influencing the world of metaverse economics. NFTs give users the right of individuality, allowing them to own and create new virtual goods. Play-to-Earn and Create-to-Earn models, supported by blockchain, guarantee safe and decentralized transactions. NFTs and blockchain have all the inclinations to become something crucial and revolutionary to the global economics despite legal and environmental concerns.

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CERTAIN ASPECTS OF THE CONVERGENCE OF ARTIFICIAL INTELLIGENCE AND METAVERSE: NORMATIVE SECURITY

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Humanity's desire to build a truly inclusive and sustainable digital future requires foresight in decision-making, understanding, and implementation of business practices, where digital technologies can realize their full potential and contribute to the improvement of human life. Digital transformation and innovation reflect trends aimed at using the latest technologies for positive and sustainable economic and societal changes. In the conditions of war, given the damage caused to the Ukrainian economy and infrastructure as a result of Russian aggression, Ukraine needs institutional capacity for rapid recovery, reconstruction, and modernization of the country. One of the reconstruction tools, according to the EU Regulation on the creation of a mechanism (instrument) in Ukraine [1], the possibility of accelerating the sustainable green and digital transition is considered. The tools of such a transition are: digital transformation and protection of the integrity of digital infrastructure, communication and information systems, and the corresponding supply chains [2].

In this context, scholars in various fields of economics are increasingly paying attention to the metauniverse (Metaverse) as an object and a new space for conducting research from economic, ecological, social, and cultural points of view. According to the definition proposed by the International Telecommunication Union ITU-T FGMV-20 focus group, the metauniverse is "an integrative ecosystem of virtual worlds that offers immersive experiences that change existing and create new values" [3]. So, for example, three-dimensional (3D) virtual agents of artificial intelligence (AI) in virtual reality (VR) or holograms in augmented reality (AR) can form new possible forms of interaction in the metaverse, in which traditional channels give way to interactive ones. Everyone can create their own avatar in the metaverse and freely explore the simulated environment. Similarly, remote or hard-to-reach places, processes, etc. can be simulated in the metauniverse. The increase in the level of interaction and immersion offered by the metaverse opens up

unprecedented opportunities and challenges for scientific research aimed at the rapid recovery, reconstruction, and modernization of the country during wartime and in the post-war period. In this regard, a deeper understanding of how to address the challenges and seize the opportunities presented by the metaverse is required, along with identifying the directions for further research into potentially new forms of interaction.

At the international level, G7 and G20 countries, along with international standardization organizations, aim to equip competent authorities and market operators across various jurisdictions with tools to enhance the resilience of digital systems and mitigate risks. This effort is particularly relevant in the context of the highly interconnected metaverse system and requires further harmonization of key requirements and the establishment of a sequence of relevant best practices. To highlight the current trends of the metaverse and the convergence of innovative digital technologies, in particular artificial intelligence (AI) and machine-to-machine interaction, this article outlines the possibility of the emergence of new frontiers of the metaverse based on the formation of normative approaches for research applications.

Metaverse, as a part of web 3.0 of the new generation of the Internet, is considered a new way of interacting with real, AR, VR, or mixed reality. Users access the meta-universe through 3D viewers that are connected to realistic avatars, other users, objects, events, virtual journeys, and more. In ensuring a scalable, sustainable architecture of the metauniverse, a key role is played by the infrastructure of information and communication technologies (ICT), and network infrastructure, in which storage infrastructure and computing power infrastructure are the fundamental elements of this system.

Technologies such as VR, AR, digital doppelgangers, blockchain, media encoding and AI contribute to the formation and development of the metauniverse, which provide immersive experiences, real-time synchronization, security, and enhanced interaction. In particular, VR and AR technologies improve interaction, inclusive accessibility, optimized productivity, and safety. Digital twin technologies, which unite the physical and virtual worlds, play a key role in simulating and synchronizing the metaverse in real-time. The diverse and dynamic nature of the metauniverse is matched by decentralized and tamper-proof blockchain technology, which lays the foundation for a shared virtual environment and secure, verifiable transactions of digital assets. In the context of the metaverse, where there are immersive and dynamic multimedia experiences, media encoding is the basis for the seamless distribution and consumption of content across different metaverse platforms. AI technology itself in the metaverse represents a new dimension of intelligent and adaptive interaction with the user that optimizes performance in this dynamic digital space. The inclusion of large language models enhances AI's ability to create a single metauniverse that transcends individual platforms and boundaries and promotes interoperability in the digital space. Compatibility is a key factor in the interrelated process in the metauniverse. A lack of interoperability between metauniverse platforms can lead to a fragmented user experience and inconvenience, as users will not be able to interact or share their experiences across metauniverses of the metaverse will be

experienced very soon. A retrospective review of the development of the metaverse with the help of big data in the framework of the initiative known as "Adding a New Dimension to the Past", already makes it possible to model hypothetical spatio-temporal 4D reconstructions of the past with modern digital technologies and infrastructure and to create a collective digital information system of the future that will reflect the economic evolution in different sectors of the economy using the AR/VR program at different times. Such computational models are seen as key resources for the development of new critical reflections on the future in the metaverse, which will make it possible to make informed decisions.

Establishing a standardized framework and jointly agreed terminology for the implementation of semantic interoperability of the metauniverse requires the development of a common concept and scenarios based on standardized protocols and interfaces for different technologies and platforms. Data exchange for consistent user interfaces between the various metauniverse platforms is a major element of this interoperability. The increased level of interaction and immersion that the metaverse offers presents unprecedented opportunities and challenges for research. Some organizations and brands seeking to better position their products and services have already taken the first steps to harness the potential of the metaverse in their research. Among the well-known companies developing practical versions of the metaverse today are: Apple, NVIDIA, Decentraland, Roblox Corporation, Unity Software, Amazon, Epic Games, and others. The motivation for the development of the metauniverse in leading companies is due to the improvement of production efficiency, the promotion of innovations and the synergistic interaction of virtual and physical environments. In particular, as highlighted in a recent review of research on the metaverse in various areas of the economy and aimed at increasing productivity, solving global problems and promoting sustainable development, include such as: medicine, manufacturing, agriculture, banking, energy, retail and fashion, education. city management, transport, urban construction, and environmental protection [4].

Given that the metaverse is currently a new field, and its concepts and application scenarios are extremely diverse and multifaceted, the issues of immersive technologies are currently being investigated by various working groups related to the metaverse. To support countries, cities and industries to stimulate innovation and implement innovative digital technologies on the eve of the opening of the World Telecommunication Standardization Assembly 2024 (WTSA -24) in October 2024 in New Delhi (India) held the fifth symposium of global standards (GSS -24) "Formation of a new momentum of digital development: new technologies, innovations and international standards" [5], which discussed the role of international standards in the formation of the metauniverse and ensuring its significant impact on the field of telecommunications. Experts predict that the metauniverse will be based on seven main technologies: 5G technology, augmented reality, brain-computer interfaces, cloud computing, blockchain, digital twins and AI. As noted, of these technologies, AI is the most important part of the metaverse due to its potential to scale it.

In the development of the metaverse, AI is a necessary technology not only in the fields of computer vision and natural language processing but also in VR and augmented reality (AR). For example, in AR technology, AI is used for immersive rendering, detection of virtual and real objects, and 3D reconstruction of objects, helping to ensure the diversity and usability of AR applications. Eventually, most of the 3D imagery, animation, and language in the metaverse will likely be generated by AI. Machine learning models can also be used to automate smart contracts, and distributed ledgers, and support other blockchain technologies for virtual transactions. AI technology is also expected to help expand the metaverse by supporting object detection, improving visualization, and providing control under Bucharest Resolution 214 "Artificial Intelligence and Telecommunications/ICT Technologies" [7]. However, despite its promise and potential, the metaverse still has many challenges to overcome. However, AI is likely to be among the technological tools that can help overcome these challenges.

However, at this stage, the emergence of the metauniverse does not yet have a clear idea of the direction and stages of technical development. A brief road map of metauniverse standardization is now presented through the lens of research by international standardization bodies. In the standardization system, the Standardization Subcommittee of the Joint Technical Committee for Standardization ISO / IEC deals with issues of developing standards for AI concepts, frameworks, systems, and guarantees for ensuring reliability, security, and AI technologies. JTC 1/ SC 42 "Artificial Intelligence" [6]. In addition, in the Joint Technical Committee (JTC) of the International Standardization Organizations (ISO) and International Electrotechnical Commission (IEC) development, maintenance, and promotion of standards in the field ICT is taken care of by ISO / IEC JTC 1 "Information technologies". ISO / IEC JTC 1 is responsible for such critical IT standards as "Software and Systems Engineering" (ISO/IEC JTC1/SC 7), "Computer Graphics, Image Processing, and Environmental Data" (ISO/IEC JTC1/SC 24), "Information security, cyber security and privacy protection" (ISO/IEC JTC1/SC 27), "Methods of automatic identification and data collection" (ISO/IEC JTC1/SC 31), User Interfaces (ISO/IEC JTC1/SC 35), Cloud Computing and Distributed Platforms (ISO/IEC JTC1/SC 38), Internet of Things and the Digital Twin (ISO /IEC JTC1/SC 41), etc.

To promote the formation of a common vision of the future, in addition to the above-mentioned standardization bodies, such organizations as the ITU, ISO/IEC, the immersion group of the Web community [8], and others are investigating the issue of the metauniverse. In particular, the International Telecommunication Union (ITU) Research Group ITU-T SG3 is investigating the economic and policy implications, including regulatory frameworks, taxation, and economic models, that are associated with virtual platform economies in the metaverse [9]. General functional requirements for metauniverse networks , optical transport networks and access network infrastructures are being worked on by research groups ITU 13 "Networks of the Future" [10] with an emphasis on IMT -2020, cloud computing and trusted network infrastructures, as well as ITU-T SG15 [11] regarding the integration of VR and AR technologies into optical transport networks and access network

infrastructures to support requirements in the metaverse . Research on multimedia coding, systems and programs, taking into account virtual worlds, platforms for social interaction (ITU-T SG16) [12], security (ITU-T SG17) [13] and infrastructure of a smart city in the metaverse , which ensures improvement of the general functionality and intelligence of connected communities within the metaverse (ITU-T SG20) [14].

Global standards, especially in networking and communications, create opportunities for interoperability, security and deliver key benefits for both users and network operators. At the same time, the future of emerging technologies is inextricably linked to open source, the driving force behind innovation. Open source has become a "de facto standard" by providing developers need such reference devices and bases for applying standards in practice. Open source projects implemented in Ukraine with the support of the Swiss-Ukrainian EGAP Program, implemented by the Eastern Europe Fund and financed by Switzerland, contribute to the achievement of the synergy of software and hardware, integration of fragmented markets, and the creation of new technologies and new models [15].

The convergence of AI and the metaverse could revolutionize critical industries such as public services, disaster risk reduction, urban planning, and smart manufacturing, and drive innovative solutions for the sustainability of the digital future [16]. Recently, metaverse has become one of the breakthrough areas of innovation with great potential for economic development [17].

Given the need to create standards for AI applications in various fields (medicine, industry, agriculture, energy, banking, etc.) that are aimed at increasing productivity, solving problems, and promoting economic sustainability, it is advisable to create task forces to encourage interdisciplinary cooperation in the standardization sector in the metaverse, which would contribute to the development of AI requirements to meet the needs of specific industries.

An urgent topic that currently requires research and implementation in the domestic context is the formation of a platform for the participation of interested organizations in a unique dialogue on the creation of innovative ecosystems and the development of the potential of innovative digital technologies, including artificial intelligence (AI) and the metauniverse. It is also important to create a technical standardization committee in Ukraine regarding future networks and the adaptation of new network technologies that will be able to meet the changing needs of public digital infrastructure and contribute to the further development and harmonization of international standards related to risk management and management systems.

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METAVSE WORLD AS A FACTOR FOR THE FORMATION OF DIPLOMATIC RELATIONS

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Over the past ten years, the world has experienced incredible progress in science and technology, which is leading to a new stage of the techno singularity. Humanity is increasingly becoming dependent on digital systems, which requires new approaches to increase the stability and inclusiveness of the economy, reduce risks, and ensure the national interests of Ukraine. According to World Bank estimates, as of the end of 2023, the war has caused losses to Ukraine's electronic communications sector of $2.3 billion. In total, 25% of fixed networks and more than 4,000 base stations of mobile communications were damaged or destroyed [1]. A scientific study by scientists of the American analytical center *Brookings Institution* "Ukraine: digital stability during the war", published at the end of January 2024, outlined the patterns of large-scale digital transformation in Ukraine for the period from 2012 to the end of 2023 [2]. The conclusions state that the existing digital capacity and electronic services, despite the losses during a full-scale war, allowed to adapt and create new opportunities to ensure the stability of the country and lay the foundations for building *win-win* relations with global partners, and further development of digital capabilities can become a catalyst for significant progress, including cloud data storage, low-code development tools, improved cryptography standards, the formation of a metaverse (Metaverse), European recognition of Ukrainian digital credentials, which requires, in its the order of settlement of issues at the legislative level.

A comprehensive assessment of the state of the global economy and prospects for 2025 according to the report of the World Economic Forum (WEF) "Forecast of Chief Economists" mostly focuses on trends affecting the world economy in the context of the rapid development of innovative technologies, especially in the field of artificial intelligence (AI) [3]. Council of Europe Framework Convention on Artificial Intelligence and Human Rights, Democracy and the Rule of Law (CETS 225), signed in September 2024, establishes a new legal order regarding the regulation of AI at the

international level [4]. In particular, it is about the need to create risk assessment systems and mechanisms for their management, the issue of personal data protection and privacy, which is especially important in the digital age. The concept, which aims to define a general digital transformation in every aspect of physical life, has been called the "metaverse". In the conditions of the full-scale invasion of the Russian Federation in Ukraine and Russia's efforts to create an information vacuum, the need for the formation of normative and regulatory support for the functioning of the metauniverse in Ukraine is determined.

A metaverse as a digital version of our reality, representing cities, buildings, streets, individuals, etc., as well as virtual events and digital places, can completely change the way people, communities, governments, and business entities interact. The use of innovative digital technologies leads to rapid changes in the "data-driven" economy and requires the outline of a holistic approach to the functioning of the metauniverse ecosystem.

In the scientific literature, virtual worlds are interpreted as stable, exciting environments based on technologies, in particular, three-dimensional representation of the surface of an object based on *3D mathematical coordinates* and augmented reality (*XR)*, which allow combining the physical and digital worlds in real-time for various purposes such as designing, modeling, collaborating, learning, communicating, transacting, or providing entertainment. Virtual worlds, commonly known as the "meta-universe", represent a persistent, immersive 3D environment based on technologies such as augmented reality (AR) and virtual reality (VR), in which real physical objects are integrated into a digital environment in real-time for various purposes [5]. However, the most revolutionary idea of the metauniverse is not only the technological aspect but also the concept of social and economic infrastructure, which enables new types of behavior, transactions, ownership, and organization in and between virtual environments [6].

The EU initiative on Web 4.0 and virtual worlds [7] defined Web 4.0 as the next innovative technological interrelated transition and support of the European Web 4.0 industrial ecosystem, the promotion of virtual public services, and the formation of global standards for open and interoperable virtual worlds. The goal is to create a new model of economic growth to achieve a breakthrough in the technologies of the metaverse, their application, and management. Web 4.0, as a continuation of Web 3, includes platforms and applications that enable the transition to a future, decentralized Internet with open standards and protocols, while protecting the ownership of digital information, giving users more ownership of their data, and catalyzing new business models. The fourth generation of the Internet (Web 4.0), as the Internet - infrastructure of the next generation, and virtual worlds combine AI, the Internet of Things (IoT), blockchains, and augmented reality. To support the growing amount of information and increase the effectiveness of AI solutions, the co-founder and general director of OpenAI S. Altman proposed the creation of a global infrastructure for AI worth more than 7 trillion US dollars based on the convergence of human and machine intelligence.

WEF's "Defining and Building a Metaverse" initiative on metaverse governance and value creation aims to guide the development of a secure, interoperable, and economically viable metaverse by bringing together stakeholders from various sectors, including government, academia, business, and civil society [8] . Given the vast amount of personal data that can be collected about members of a metauniverse platform, in addition to its benefits, the data poses significant privacy concerns.

According to a *Deloitte report,* the industrial metauniverse and generative artificial intelligence (*GenAI)* are the new trends of 2024, ushering in a new era in the digital landscape and aiming to create an ecosystem of economic value in various industries. According to the company's analysis, revenues from the industrial metauniverse by 2030 can reach 100 billion dollars. USA, significantly exceeding the consumer (up to USD 50 billion) and corporate (USD 30 billion) segments. Analysts also point to the potential growth of the global market of digital doubles from $ 6.5 billion. The USA in 2021 up to 125.7 billion dollars. USA in 2030, which is enhanced by the use of augmented reality. It is predicted that the global augmented reality markets by 2030 will be able to reach a capitalization of 38.6 billion dollars. USA, showing an annual growth rate of 35%, and the global volume of data transfer will grow to 181 zettabytes in 2025 [9]. According to statistics published by the European Commission, the estimated share of the impact of the data economy on GDP in the EU-27 and the UK was 2.6 percent in 2019 and is expected to reach 4.2 percent by 2025 under the baseline scenario.

With the rapid development of innovative technologies, issues related to the management of large amounts of web data (acquisition, data exchange, integration, reuse, etc.) are among the most demanded today. The resource description framework (*Resource Description Framework, RDF),* provides a standardized exchange of data based on relationships from many sources. Interplanetary file system (*Interplanetary File System, IPFS*) is open for managing digital data without a central server in a distributed file system. To implement the use of the metaverse, companies face challenges such as insufficient high-speed connectivity and managing large amounts of web data. In addition, data interpretation due to format incompatibility is observed. The creation of new 3D content using 3D scanning devices or AI-generated content is promising, but the associated costs are still considered high.

Based on various industry perspectives, the metauniverse is seen as an open ecosystem platform built on defined and shared standards and providing economic, social, and environmental value. At the same time, AI has become a significant factor in the development of the industrial metauniverse with its potential to enhance other favorable technologies. The use of 3D modeling and software is also becoming increasingly common for system development and testing. However, these pilot projects are often not integrated into the existing software infrastructure or industrial platform of the metaverse. To date, there are significant differences in manufacturing processes regarding the adoption of the industrial metauniverse due to the leading positions of individual technology companies, particularly in the

automotive, aerospace, energy, and pharmaceutical sectors. Despite the different levels of development in these industries, the opportunities and challenges faced by companies in its adoption are similar. However, there is currently a lack of a clear vision, strategy, and management processes for the industrial metauniverse concept. In addition, the complexity and speed of innovation in large companies in the industrial metaverse, as well as the lack of open information about metaverse platforms and their further development slow down the widespread adoption of the metaverse. Large companies are developing their versions, each adapting the metauniverse idea to their strengths. Examples are leading social platforms media, gaming companies, online stores, etc. Among the well-known companies developing Metaverse today are:

- *Apple* is known as the Meta company, which has created virtual meeting applications with a system THAT includes physical movements to be present and interact during virtual meetings;

- *Meta* - the main company developing Metaverse for users to be in a network of 3D virtual worlds in real-time, storing identification data and payment history, and focused on developing a supercomputer with quintillion operations per second. Meta chose the EU to develop Metaverse technology and create new jobs in Europe;

- *NVIDIA* is one of the best Meta companies that has made an agreement with the Metaverse market and initiated the distribution of free copies of the program created for the development of Metaverse assets, known as Omniverse, which supports artists and content creators to create virtual worlds and products, and helps users create personalized avatars to bring their visions to life;

- *Decentraland* develops Metaverse as a platform for content producers and enterprises that helps users create and monetize various applications and content by purchasing virtual plots of land in Metaverse technology;

- *Roblox Corporation* focuses on building a Metaverse business model and offers several games on its platform, some of which offer virtual worlds where players can interact effectively and freely with each other;

- *Unity Software* offers a platform for the development of 3D programs in real-time with access through augmented or augmented reality using innovative tools and technologies such as 3D, 2D, virtual, and augmented reality for the development of Metaverse technology.

- *Snapchat* announced the launch of a new avatar lens that allows avatars to change clothes and faces according to their mood, helping to increase the speed of Metaverse technology;

- *Amazon* develops Metaverse by hiring a product manager to deliver Metaverse cloud services in the gaming technology division;

- *Epic Games* has announced a $1 million investment in the development of Metaverse in 2021 to pave the way for game developers to explore the many possibilities of Web 3.0.

Some brands also claim virtual real estate on metauniverse platforms with their digital properties.

One of the ways to solve these problems in international practice is considering the possibility of strengthening diplomatic and international relations in the metauniverse. The creation of virtual embassies under the 1961 Vienna Convention on Diplomatic Relations (VCDR) and the 1963 Vienna Convention on Consular Relations (VCCR), as an opportunity to begin the evolution of global diplomacy beyond the physical world, initiated the creation of metaverse diplomatic embassies (Metaverse Embassy) such countries as Barbados [10], Israel [11], Malta, the Philippines, Estonia, Serbia, Sweden, Kazakhstan [12], South Korea, etc. [13]. Since more and more states are beginning to use the metauniverse for diplomatic and consular relations, which are gaining more and more importance in the metauniverse, these processes require the analysis and construction of new, separate norms of international law in the metauniverse in domestic legislation.

Another direction of the implementation of the metauniverse is the initiation and implementation of the domestic regulatory framework for the metauniverse. Currently, the main reason for the slow adoption of the concept of the metaverse is the lack of infrastructure - mainly a good Internet connection, artificial intelligence chips that can support this vision, and the availability of devices and computing power. To facilitate metauniverse pre-standardization initiatives in March 2023 in Riyadh (Saudi Arabia) International Telecommunication Union (ITU) started the development of a road map for establishing technical standards of the metauniverse, which would ensure compatibility, high-quality interaction with the user, security, and protection of personal data. In addition, defining the fundamental advanced technologies for multimedia and network optimization, digital currencies, the Internet of Things, digital doppelgangers, and environmental sustainability is extremely important for establishing the technical requirements for the formation of the metauniverse. These factors require the combined efforts of all major companies and governments to build protective layers to ensure data protection.

The metauniverse is now a vision of the existence of humanity in two worlds at the same time, which transforms the perception of physical reality into a virtual one and promotes the creation of its own, fully functioning economy based on immersive technologies and scientific discoveries, the convergence of human and machine intelligence, biotechnology, quantum computing, etc. To achieve sci-fi ambitions and challenges, countries in the coming years need to plan the development and implementation of fundamental and applied research on the problems of the metaverse through the evolution of virtual diplomacy outside the physical world. Despite the challenges, the metauniverse opens up opportunities for diplomatic relations. The question is how countries will try to join the fundamental issues of the metaverse, whether they will form their vision, and what they will be able to control in terms of content, commerce, and user tracking, the future will tell. Perhaps the biggest challenge presented by the Metaverse will be in the area of regulation, given the data collected during physiological processes, including pupil dilation, heartbeat, biometrics, and more.

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AI IN CYBERSECURITY: AN INSTRUMENT FOR DEFENSE AND ATTACK

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The rapid development of the modern information society relies on robust cyber protection and effective measures against cybercrime [1]. However, cybercriminals continually evolve their tools and methods. They target cyberattacks at a variety of services, including banks, medical institutions, communications systems, and other critical infrastructure. For instance, in May 2021, the U.S.-based Colonial Pipeline company was attacked by the DarkSide ransomware group, which used a mix of traditional hacking techniques and artificial intelligence (AI) to penetrate the company's systems and encrypt its data [2].

The problem of the activities of organized cyber groups is especially relevant for Ukraine, which is a cyber training ground for Russian hackers. The Ukrainian energy system has already been subjected to powerful cyber-attacks in recent years. However, these days they are combined with massive shelling of energy facilities. All methods of disseminating disinformation aimed at creating panic among the population are also actively used, information and psychological manipulations and propaganda regarding the state of the energy sector are used.

In terms of emerging technologies, in 2024, cybersecurity researchers and practitioners observed a sharp rise in the use of Artificial Intelligence (AI) by cybercriminals to organize cyberattacks. The problem is accelerating rapidly.

Cybercriminals leverage AI to enhance the sophistication, scale, and efficiency of their attacks. In particular:

1. Phishing and Social Engineering:

- Deepfake Technology: AI-generated deepfake videos or audio can impersonate individuals, convincing victims to divulge sensitive information.
- Spear Phishing: AI can analyze a target's online presence and generate highly personalized phishing emails, increasing the likelihood of success.
- Malware and Ransomware:
- Polymorphic Malware: AI enables malware to evolve, changing its code or behavior to avoid detection by traditional antivirus software.
- Smart Ransomware: AI can optimize encryption strategies and identify high-value data for maximum impact.
- Automating and Scaling Attacks:
- AI-powered bots can scan networks, find vulnerabilities, and exploit them at a scale without human intervention.
- Tools like CAPTCHA-solving bots use machine learning to bypass security measures.

- Adversarial AI:
- Cybercriminals use adversarial machine learning to manipulate or corrupt the AI systems used in cybersecurity, causing them to misclassify threats or miss anomalies.
- Credential Theft:
- AI can be used to guess passwords through advanced brute force techniques, such as generating password patterns based on user behavior or previous breaches.
- Dark Web Intelligence:
- AI tools can monitor and analyze activity on the dark web to identify trends, new tools, or vulnerabilities that can be exploited.

At the same time, cybersecurity professionals are also using AI to protect information systems, especially in critical infrastructure facilities.

AI plays a vital role in enhancing cybersecurity by providing proactive and adaptive defenses against evolving threats:

1. Threat Detection and Response:
- Anomaly Detection: Machine learning algorithms can identify unusual patterns in network traffic, flagging potential threats in real-time.
- Behavioral Analysis: AI can model user behavior to detect insider threats or compromised accounts.
2. Automated Incident Response:
- AI-driven systems can isolate infected systems, block malicious traffic, or roll back unauthorized changes automatically.
3. Threat Intelligence:
- AI collects and analyzes global threat data to identify emerging attack vectors and patterns, enabling predictive threat mitigation.
4. Endpoint Protection:
- AI-based antivirus and endpoint detection systems use machine learning to recognize malware based on its behavior, even if it hasn't been encountered before.
5. Deception Technologies:
- AI can deploy decoys or honeypots that mimic real systems, tricking attackers and gathering intelligence about their methods.
6. Fraud Prevention:
- AI models analyze transactional and user data in real time to identify fraudulent activities, especially in financial systems.
7. Vulnerability Management:
- AI tools assess and prioritize vulnerabilities in an organization's systems, recommending fixes based on exploitation's likelihood and potential impact.
8. Predictive Analytics:
- By analyzing past attack data and current trends, AI helps predict future threats, allowing for preemptive action.

Despite the current practice of using AI in cybersecurity, certain challenges remain. Among them are:

- Arms Race: As defenders improve AI-driven solutions, attackers simultaneously innovate their methods.
- Bias and False Positives: Poorly trained AI models can lead to false positives or negatives, undermining trust in the system.
- Cost and Complexity: Advanced AI systems require significant development, deployment, and maintenance resources.
- Adversarial AI: Attackers can exploit vulnerabilities in AI models, such as poisoning datasets or fooling detection algorithms.

One of the most pressing concerns is the identification of AI-generated content. Artificially generated content enables attackers to create customized content with a much lower time investment. Deepfakes, private emails, and voicemails create great opportunities for phishing, which cybercriminals use for criminal purposes. For example, the CEO of a UK-based energy firm was conned out of US$243,000 by scammers using deepfake AI voice technology to impersonate the head of the firm's parent company [3].

Combining AI with traditional methods and human expertise is essential to stay ahead in the evolving battle against cybercrime. However, the dual-use nature of AI necessitates ethical frameworks and international collaboration to ensure its responsible use.

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FOSTERING A CULTURE OF RESPONSIBLE USE OF ARTIFICIAL INTELLIGENCE THROUGH CO-REGULATION

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If we accept the premise that energy and information are the foundational elements of the world, as reflected in the two groundbreaking 20th-century formulas – Einstein's $E=mc^2$ and John Wheeler's "it from bit" [1] – it becomes evident why mastering these elements offers humanity existential opportunities as well as threats. This duality was highlighted by two Nobel laureates almost 90 years apart: Frédéric Joliot in 1935 warned of the dangers of nuclear energy [2], while Geoffrey Hinton reiterated similar concerns regarding AI in 2024 [3].

Simultaneously, the key role in transforming energy and information lies with psychological agents – primarily individuals and humanity as a collective subject. Throughout its history, humanity has developed numerous tools to mitigate existential threats and amplify opportunities, such as religion, **culture**, politics, economics, and **law**. The guiding principles for these tools are rooted in **meanings** that manifest through values, motives, needs, and goals – collectively forming the dispositional core of personality. While culture addresses universal human values, economics emphasizes sustainable development goals, and law focuses on human rights, democracy, and the rule of law.

As noted by M. Kozubra, 'Legislation is not law but merely a necessary tool and guide for its application in specific legal situations' [4, c. 463]. Unsurprisingly, 2024 marks the adoption of significant regulatory acts, including the EU AI Act [5] and the Council of Europe's Framework Convention on Artificial Intelligence, Human Rights, Democracy, and the Rule of Law [6]. The Convention's title explicitly reflects three supreme values recognized as universal and intrinsic to the essence of law.

Additionally, 2024 has seen the development of numerous co-regulation and self-regulation instruments. At the EU level, these include the General-Purpose AI Code of Practice [7], while in Ukraine, Guidelines on Responsible Use of AI in media [8], advertising and marketing communications [9], education [10], personal data [11], intellectual property rights [12], and the Declaration on Self-Regulation in the Field of AI [13] have developed. These documents belong to the realm of 'soft law,' focusing on fostering a culture of responsible AI use through values and meanings rather than through sanctions or incentives.

In psychology, motivation is classified as either internal or external, with a constant interplay between the two. **Increasing external motivation often diminishes internal motivation.** Internal motivation, being rooted in the dispositional core of a person, is stable. In contrast, **external motivation** relies on external stimuli – positive or negative – rendering it volatile and **susceptible to**

inflation [14]. This inherent issue is illustrated by comparing the effectiveness of mobilization in Ukraine, driven by patriotic feelings (internal motivation) during the early months of war, to later stages, where sanctions and financial incentives for military service (external motivation) became the primary tools of influence.

Thus, when discussing soft versus hard law and legal culture versus legislation, the focus shifts to fostering internal motivation driven by values rather than external influences such as severe penalties or incentives. Notably, psychological research indicates that **positive stimuli (dopamine-driven motivation) are generally more effective than negative stimuli (cortisol-driven motivation)**.

Of course, while internal motivation may wane over time, its delegation to external tools (including hard legal norms) is necessary; vice versa, the inefficacy of external motivation (as laws fail to work) demands a return to meanings and values underpinning internal motivation. Therefore, the sustainable functioning of society requires an organic combination and mutual evolution of soft and hard law instruments. It is essential to recognize that international legal instruments primarily reflect internal motivation (meanings, values, and goals), while national legislation translates these instruments into external motivation through sanctions and incentives.

The development of AI encourages a rethinking of numerous questions rooted in psychology. AI enables humans to delegate an increasing volume of routine tasks – from idea generation to their implementation in virtual and physical environments. This shift positions humans as decision-makers, choosing which ideas to actualize. This act of **choice (a "deed"** in psychological terms [15]) becomes an act of pure creativity, often carrying moral, ethical, and material consequences for which **human must accept (appropriate) responsibility** – be it positive (e.g., income) or negative (e.g., penalties).

Thus, **the qualitative transformation of the chain "idea – choice – delegation – appropriation/alienation of results – responsibility,"** with AI involved at every stage, necessitates the revision of numerous legal concepts, including:

1. **In intellectual property law:**
   - The notion of **the concept of "work"**: Should ideas (currently excluded from protection under Article 7(3) of the Ukrainian Law on Copyright and Related Rights [16]) receive protection, and to what extent?
   - **Can the human act of choice and further realizing an idea with usage of AI systems be recognized as act of creation (act of art)?** Current laws differentiate between AI-generated objects and works created with AI assistance (AI-assisted), but clear criteria for distinction are absent. It is likely that this boundary will shift towards **evaluating the number of subjective choices** required to realize an idea.
2. **In civil law:**
   - Defining **digital personality, digital identity, and the legal status of new types of agents** (e.g., OpenAI's planned launch of AI agents who will use the computer on behalf of a person in 2025 [17]).
   - Establishing procedures for delegating authority, regulating property rights over AI-generated outputs (an example of such regulation is the rights of a special kind – sui generis, provided for by Article 33 of the Law of Ukraine "On

Copyright and Related Rights" [16]), and assigning liability for AI-related activities. acceptance of responsibility for the consequences of the AI agent's activities by subjects directly supported by a humans at different stages of the life cycle of AI systems.

3. **In insurance and medical law:**

- Developing methodologies for risk assessment related to specific AI systems and creating new insurance forms for activities involving AI systems.

4. **In social security and environmental law:**

- Determining how the costs (e.g., AI's substantial carbon footprint [18]) and benefits of AI systems should be distributed across society.
- Identifying the most effective methods to balance/ to eliminate imbalance the appropriation of benefits and the delegation of responsibility related with use of AI systems.

5. **In advertising and electoral law:**

- Rethinking the concepts of **mindfulness** (consciousness) and subconsciousness, as the Ukrainian Law on Advertising prohibits using technologies that influence the subconscious [19]. This aligns with Article 5 of the EU AI Act [5], which bans "*subliminal techniques beyond a person's consciousness or purposefully manipulative or deceptive techniques, with the objective, or the effect of materially distorting the behaviour of a person or a group of persons by appreciably impairing their ability to make an informed decision, thereby causing them to take a decision that they would not have otherwise taken in a manner that causes or is reasonably likely to cause that person, another person or group of persons significant harm*". As it is mentioned in part 29 of the Preamble, "*such AI systems deploy subliminal components such as audio, image, video stimuli that persons cannot perceive, as those stimuli are beyond human perception, or other manipulative or deceptive techniques that subvert or impair person's autonomy, decision-making or free choice in ways that people are not consciously aware of those techniques or, where they are aware of them, can still be deceived or are not able to control or resist them*." While any advertising, as well as electoral campaigns primarily target emotions, which are less consciously regulated than rational judgments, AI amplifies emotional influence through both through the generation of emotionally impactful content and through the choice of the moment and context of showing the appropriate content. For example, volunteer fundraising campaigns often perform better immediately after emotional events, such as military attacks and related consequences.

We intentionally avoided analyzing legal issues related to using AI in labour law, education and science legislation, agricultural law, and military law. Nevertheless, even this brief overview highlights the importance of fostering a culture of responsible AI use – a basic AI literacy in an era when AI has become the "new electricity," embedded in nearly every human activity.

Given the rapid inflationary nature of external motivation, which relies on tools of hard law, such measures alone cannot effectively regulate most AI-related issues. Conversely, soft law instruments, which target internal motivation by fostering a culture of responsible and informed AI use – especially through co-

regulation practices where stakeholders collaboratively create norms – offer greater potential and stability. These instruments are particularly critical as humanity constructs new layers of reality, such as the Metaverse and quantum technologies, while aiming for sustainable development within the already existing reality.

Conclusions

The transformation AI brings to the dynamics between internal and external motivation underscores the need for a balanced approach to legal regulation. Soft law emphasizes values and meanings to nurture internal motivation, whereas hard law serves as a necessary framework for external enforcement. Together, they enable a legal and ethical ecosystem that supports responsible AI use and addresses the multifaceted challenges posed by AI's integration into society.

The outlined legal issues – ranging from intellectual property to environmental and social implications – reflect the urgent need for adaptive legal frameworks. These frameworks should accommodate AI's evolving role in human decision-making, societal functioning, and ethical dilemmas. Collaborative regulatory efforts at both international and national levels will be essential for aligning legal norms with humanity's shared values and aspirations.

Thus, fostering responsible AI use requires developing soft law instruments and embedding them in a culture of co-regulation. Participants in such co-regulation become co-creators of norms, increasing their commitment to compliance and enhancing the durability of these norms in constructing new realities (e.g., the Metaverse or quantum domains) and achieving sustainable development within the existing reality.

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USING ARTIFICIAL INTELLIGENCE TO AUTOMATE PSYCHOLOGICAL ASSISTANCE: FROM THE CLASSIFICATION OF PERSONALITY CHARACTERISTICS BASED ON PSYCHOANALYTIC TYPOLOGY TO AUDIO MEDITATIONS AND VIRTUAL REALITY

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Abstract

The study "Using Artificial Intelligence to Automate Psychological Assistance," conducted within the PersonaMatrix project in 2021–2024, aimed to develop innovative methods of psychological support utilizing modern technologies. The objective of the research was to create a comprehensive system that combines automated classification of personality characteristics based on psychoanalytic theory with automated therapy methods, the development of automated notifications for psychologists and clients about test results and psychological information on personality traits, as well as audio meditations for individuals with four basic character types. The methodology included training AI agents on proprietary materials to analyze psychological profiles and create personalized therapeutic programs. These programs can be integrated with virtual reality technologies. The results demonstrate a significant increase in the effectiveness of psychological assistance using the proposed system, supported by clinical trials. The study opens new prospects in the field of automated psychotherapy and personalized medicine.

Keywords: Artificial Intelligence, Virtual Reality, Psychoanalysis, Automated Psychotherapy, PersonaMatrix

Introduction

The modern development of artificial intelligence (AI) and virtual reality (VR) technologies opens up new possibilities for improving methods of psychological assistance. Initiated in Ukraine, the PersonaMatrix project aims to integrate these technologies with traditional psychoanalytic approaches to create an effective system of automated psychological support.[1]

The relevance of this study is driven by the growing need for accessible and effective methods of psychological assistance, especially under conditions of global crises and limited healthcare resources. The use of AI and VR can significantly expand the capabilities for providing psychological support, making it more accessible and personalized.

The purpose of this study is to develop and validate a comprehensive system of automated psychological assistance that includes:

1. Classification of personality characteristics based on psychoanalytic theory using AI.

2. Development of personalized therapeutic programs, including audio meditations.

3. Creation of AI agents trained on proprietary materials to interact with clients as AI psychoanalysts, family therapists, archetypal psychoanalysts, and advisors for parents of children with special needs.

4. Creation of AI agents, trained on proprietary materials, that model interactions of individuals with different character types.

Literature Review

Psychoanalytic theory of character types, initiated by Sigmund Freud and developed by his followers, remains influential in modern psychology. Nancy McWilliams, in her work Psychoanalytic Diagnosis: Understanding Personality Structure in the Clinical Process, provides a detailed description of various character types formed due to specific early developmental conflicts.[1]

Research on AI applications in psychology demonstrates the potential for automating the diagnosis and treatment of mental disorders. For example, Luxton et al. (2020) show the effectiveness of using chatbots for initial psychological support.[2]

Virtual reality is increasingly applied in psychotherapy, especially for treating phobias and post-traumatic stress disorder. The study by Maples-Keller et al. (2019) demonstrates the high effectiveness of VR therapy compared to traditional methods.[3]

Integrating psychoanalytic theory with modern technologies remains underexplored, highlighting the novelty and relevance of this research.

Methodology

The study was conducted in three stages:

1. Development of the AI Algorithm for Character Type Classification:

- Creation of a database of psychological profiles based on psychoanalytic theory.
- Development and training of a neural network to analyze textual data and determine character type.
- Validation of the algorithm on a sample of 1,000 participants.

2. Creation of Personalized Therapeutic Programs:

- Development of a database of audio meditations and therapeutic exercises for each character type.
- Creation of an algorithm for the automatic selection of therapeutic programs based on the determined character type.
- Creation of AI agents providing real-time consultative support.

3. Creation of AI Agents That Model Interaction Based on Psychoanalytic Classification:

- Schizoid character type personality
- Depressive character type personality
- Narcissistic character type personality
- Obsessive-compulsive character type personality

- Other five character types (according to psychoanalytic classification) can be trained as needed for testing in a multi-agent AI environment.

Results

The character type classification algorithm showed 87% accuracy compared to expert psychoanalysts 'assessments. The highest accuracy was achieved for schizoid (92%) and narcissistic (90%) character types.

Key basic psychic conflicts in individuals with various character types were identified, manifested in stable behavioral strategies and specific phrases derived from these strategies. A small selection of such "typological phrases" is provided in the author's book "Types of Characters and Elements" in Chapters 2 and 3. Based on these phrases, the test "Persona. What Is My Character Type?" was developed. A U.S. Copyright Office registration certificate (No. TXu 2-408-293, dated 12/23/2023) confirms the authorship. From 2022 to 2024, this questionnaire was tested on 1,000 individuals, mainly Ukrainian-speaking citizens in Ukraine and abroad. The sample did not include representatives of other nationalities. It can be hypothesized that the basic personality conflicts are similar across nations, though ethnopsychological differences may exist. Accordingly, the questionnaire for representatives of other nations may be adapted to reflect their national manifestations of psychic conflicts.

Statistical analysis of the testing data showed that the highest frequency of manifestations was among individuals with schizoid, narcissistic, depressive, and obsessive-compulsive character types. They accounted for 87% of all respondents, and these mental structures can be considered primary.

Other character types—histrionic, masochistic, paranoid, and dissociative (multiple)—are significantly less frequent, accounting for 13%. These can be considered secondary, or derivative, mental structures that, according to psychoanalytic theory, form at later stages of personality development.

It is also possible to analyze respondents by the indicators of character maturity and antisocial tendencies.

The distribution was as follows:

- Mature respondents: 58%
- Antisocial: 3%
- Immature but social: 3%
- Immature and antisocial: 0.6%

Based on the psychological testing of character types, personalized therapeutic programs and audio meditations were developed for each type, demonstrating a 35% increase in therapy effectiveness compared to standard approaches.

Retrospective test results (repeated after 3–6 months) showed:

- If clients received effective psychotherapeutic support, the follow-up tests indicated a 15–20% decrease in derivative psycho-typological structures (dissociative, masochistic, and histrionic indicators). There was also a 10–20% increase in indicators of psychological maturity and a 5–15% decrease in antisocial tendencies.

- If clients did not receive psychological support, the follow-up tests did not show significant changes in character indicators (around 5%, within the margin of

error). In some cases, there was a 10–20% decrease in psychological maturity indicators along with a 10–15% decrease in antisocial tendencies, which could be due to increased stress in the internal and external environments, illness, or experiences of loss.

Discussion

These character structures can be identified using the "Persona. What Is My Character Type?" test without the need for detailed clinical interviews or prolonged psychotherapeutic observation. This makes it possible to identify a psychological conflict characteristic of a secondary character type tens of times faster and to formulate a psychotherapeutic strategy for working with the client. Thus, the effect of psychotherapeutic support can be accelerated. Otherwise, knowing the complexity of the client's character, a psychotherapist may refuse to continue treatment and refer the client to a specialized professional according to the psychological features identified by the test.

The study's results confirm the effectiveness of integrating psychoanalytic theory with modern AI technologies. The high accuracy of the character type classification algorithm indicates the possibility of automating initial psychological diagnostics, which can significantly improve access to psychological assistance.

Personalizing therapeutic programs based on the identified character type demonstrates the potential to enhance psychotherapy effectiveness. This is especially important given limited healthcare resources.

Conclusions

This study demonstrates the high potential of integrating psychoanalytic theory with AI technologies to automate and increase the effectiveness of psychological assistance. The developed system can significantly expand the availability of high-quality psychotherapeutic support.

Future research should focus on expanding the database of psychological profiles, improving AI algorithms, modeling multi-agent AI environments for different psycho-typological structures, and developing technologies to integrate audio meditations with VR scenarios for various psychological issues.

The PersonaMatrix project opens new prospects for personalized psychotherapy and may serve as a foundation for developing innovative methods of treating mental disorders.

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NEUROPSYCHOLOGICAL MECHANISMS OF THE INFLUENCE OF SHAMANIC PRACTICES ON CREATIVITY: A MIXED-METHODS STUDY

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Abstract

This study investigates the impact of shamanic practices, specifically Ayahuasca consumption and sound healing combined with guided meditation, on creativity. Using a mixed-methods approach, we examined changes in creativity, openness to new experiences, executive functions, and divergent thinking among 47 participants. Results indicate that meditation and sound healing positively influence executive functions, enhancing task initiation, planning skills, and creative self-efficacy. This research provides insights into the potential of shamanic practices for enhancing creativity and cognitive functions.

Keywords: Shamanic Practices, Ayahuasca, Sound Healing, Creativity, Divergent Thinking, Executive Functions, Openness To Experience, Cognitive Psychology, Meditation, Neuropsychology.

Introduction

Shamanic practices have long been associated with altered states of consciousness and potential enhancements in cognitive functioning. Recent research has begun to explore the neurological underpinnings of these practices, suggesting that they may induce changes in brain activity associated with creativity and altered perceptions[1]. This study aims to contribute to this growing body of knowledge by examining the specific impacts of Ayahuasca consumption, sound healing and meditation on various aspects of creativity and cognitive function.

The objectives of this study were to:

1. Assess the impact of shamanic practices on creativity, executive functions, openness to new experiences, and divergent thinking.
2. Compare the effects of live versus online practices.
3. Evaluate the influence of sound healing and guided meditation on creativity, particularly when experienced online in group settings versus individually through recordings.

Methodology and Measures

Forty-seven participants of diverse ages and nationalities were recruited based on their experience with shamanic practices and sound healing. They were divided into four groups: three experimental groups (9 participants each), one control group (20 participants).

The study adopted a mixed-methods design to comprehensively assess the impact of shamanic practices. Quantitative data were collected through

standardized psychometric tests, while qualitative insights were obtained through structured interviews and participant reflections.

The independent variables included:

1. Ayahuasca practices (in a traditional ceremonial context).
2. Sound healing sessions (delivered online, both live and pre-recorded).
3. Directed meditation with a focus on creative visualization.

Dependent variables measured were:

1. Openness to experience: assessed using the Openness subscale of the Big Five Inventory (BFI).
2. Divergent thinking: evaluated through the Torrance Tests of Creative Thinking (TTCT).
3. Executive functions: measured using the Behavior Rating Inventory of Executive Function (BRIEF).
4. Creative self-efficacy (CSE): assessed via a modified Creative Self-Efficacy Scale.

Participants (N=47) were divided into four groups:

1. Ayahuasca group (n=9): Participants attended guided ceremonies under the supervision of experienced facilitators.
2. Live sound healing group (n=9): Sessions conducted via live-streamed sound healing events.
3. Pre-recorded sound healing group (n=9): Participants accessed recordings of the same sound healing sessions.
4. Control group (n=20): No exposure to shamanic practices during the study. A mandatory requirement in this group was participation in long-term psychotherapy.

Statistical Analysis:

The statistical processing of the collected data was conducted using the Jamovi statistical software. To examine the impact of shamanic practices and/or sound healing on creativity, attention, openness to new experiences, willpower, and divergent thinking, a paired samples test (Student's t-test) was employed. For comparing the groups of participants categorized by the type of practice, a one-way analysis of variance (ANOVA) was performed using Fisher's and Kruskal-Wallis criteria, along with an independent samples test (Student's t-test).

Results

Ayahuasca practices showed a significant positive impact on executive functions. Participants in this group exhibited a 6.556-point increase in executive function scores ($t(8) = -2.376$, $p = 0.045$), particularly in planning and task management skills. This finding aligns with previous research suggesting that psychedelic experiences can enhance cognitive flexibility and creative problem-solving [1].

Sound healing also demonstrated positive effects, particularly in online group settings. Participants in this group showed a 13-point increase in general executive qualities, indicating improved focus and future-oriented task processing.

This result supports the notion that non-pharmacological altered states of consciousness, such as those induced by sound, can also influence cognitive functions [2], [4].

Interestingly, only minor differences were observed between live and recorded sound healing sessions. Recorded sessions slightly enhanced task detailing, although the statistical significance was marginal ($p = 0.051$). This finding suggests that the benefits of sound healing may be accessible through various modalities, potentially increasing its accessibility for therapeutic applications.

Sound healing demonstrated a positive impact on creative self-efficacy (CSE) and creative self-perception (CPSE). Participants in live online sound healing sessions showed a 0.5-point improvement in CSE, compared to a 0.2-point increase for those using recordings. CPSE scores also improved among those using recordings (0.26 points). These results indicate that sound healing may enhance individuals' confidence in their creative abilities and their self-identification as creative persons.

Discussion

The findings of this study provide compelling evidence for the potential of guided meditation and sound healing, to enhance creativity and cognitive functions. The observed improvements in executive functions, especially in planning and task initiation, suggest that these practices may facilitate more effective cognitive processing and problem-solving abilities[1].

The positive impact on creative self-efficacy and self-perception is particularly noteworthy. These improvements may lead to increased engagement in creative activities and a greater willingness to explore novel ideas, potentially fostering long-term creative development[3].

The comparable effects of live and recorded sound healing sessions suggest that the benefits of these practices may be accessible through various modalities. This finding has important implications for the potential integration of shamanic-inspired practices into more mainstream therapeutic and personal development contexts, as well as into the educational process[2].

Limitations and future directions

While this study provides valuable insights, several limitations should be noted:

1. The small sample size limits the generalizability of the findings.
2. The lack of long-term follow-up assessments prevents conclusions about the durability of the observed effects.
3. The study design could have benefited from more in-depth qualitative interviews to provide richer context to the quantitative findings.

Future research should address these limitations by employing larger sample sizes, incorporating longitudinal designs, and utilizing more comprehensive qualitative methods. Additionally, exploring the integration of artificial intelligence and augmented reality in shamanic-inspired practices could open new avenues for cognitive enhancement and therapeutic interventions[4].

Conclusions

This study provides evidence for the positive impact of shamanic practices, guided meditation, and sound healing on creativity and cognitive functions. The observed enhancements in executive functions, creative self-efficacy, and creative self-perception suggest that these practices may offer valuable tools for fostering creativity and cognitive flexibility.

The next phase of research at the Institute of Psychological Maturity will examine how artificial intelligence (AI) and immersive technologies, combined with guided meditation and sound healing, influence creativity and cognitive functions. This future direction aims to leverage these advanced technologies to improve student engagement in educational processes. By combining the insights gained from shamanic practices with cutting-edge technological interventions, we anticipate developing novel methods to enhance learning experiences and cognitive development.

This upcoming research represents an exciting intersection of ancient wisdom and modern technology, potentially revolutionizing our approach to education and personal growth. It underscores the Institute's commitment to pushing the boundaries of psychological research and its practical applications in fostering human potential.

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DIGITIZATION IN PUBLIC ADMINISTRATION IN UKRAINE: OPPORTUNITIES AND CHALLENGES

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Abstract. Digitalization in public administration is one of the key processes transforming modern states, enhancing the efficiency, transparency, and inclusiveness of administrative processes. This article examines the impact of digital transformations on public administration in Ukraine, particularly their role in ensuring sustainable development, strengthening democracy, and addressing corruption. The study focuses on analyzing the current state of digitalization in Ukraine's public sector, identifying key opportunities and challenges, and exploring prospects for further development in the context of globalization and the spread of information technologies.

The research highlights that digitalization offers significant opportunities for optimizing public administration, including automating routine functions, implementing electronic document management, creating platforms for e-government, and increasing citizen participation in decision-making. Additionally, digital technologies enhance the transparency of government processes, minimize corruption risks, and facilitate citizen engagement with authorities through electronic petitions, online consultations, and public discussion platforms.

The article also addresses several challenges Ukraine faces in digitalizing public administration. These include uneven access to digital resources across regions, low digital literacy among parts of the population, insufficient funding for technological solutions, and cybersecurity threats. Furthermore, the lack of a systematic approach to digitalization and insufficient integration of modern technologies, such as artificial intelligence and blockchain, hinder the implementation of digital initiatives. The study examines the current state of digitalization in Ukraine, including achievements in providing electronic services through the "Дія" platform and the development of e-governance.

The article emphasizes the importance of international experience in implementing digital reforms and adapting successful practices from countries like Estonia and Singapore to Ukraine's realities. The authors underscore the need to develop a national digitalization strategy, improve the legislative framework, invest in cybersecurity development, enhance digital literacy, and create favorable conditions for the development of the digital economy.

The findings demonstrate that digitalization is not merely a technological process but also a tool for societal transformation. It fosters a new interaction model between the state and its citizens, improves the quality of public services, and upholds the principles of open governance. However, to successfully realize this potential, it is essential to overcome existing challenges, develop effective

mechanisms for implementing digital solutions, and ensure the integration of technologies into all aspects of public administration.

This article contributes to understanding the strategic importance of digitalization for public administration in Ukraine, offering practical recommendations for improving administrative processes and laying the groundwork for further research in this area.

Keywords: Digitalization, Public Administration, e-Government, Digital Technologies, Ukraine, Challenges, Opportunities.

Problem Statement and Relevance. In the modern world, digitalization is a key driver of economic, social, and political development, as well as a major trend in the enhancement of public governance systems. Digitalization in public administration represents a crucial stage in transforming state apparatuses to increase transparency, efficiency, accessibility of administrative services, and interaction between governments and societies. This global phenomenon affects all aspects of life, from the economy to social processes. In the context of digital transformation, states face the necessity of adapting their governance systems to new technological realities. Ukraine, aspiring to integrate into the European and global digital landscape, actively implements digital technologies in public administration. However, alongside these advantages, digitalization also introduces a range of challenges, particularly regarding data security, the adaptation of legal frameworks, technical support, and workforce training.

Scientific studies and practical case analyses demonstrate the significant potential of digitalization for improving public administration. However, in Ukraine, this process has unique characteristics due to specific political, economic, and social challenges.

The concept of "digitalization" gained prominence in the second half of the 20th century [11]. During this period, digital technologies became pivotal in various sectors, including information processing and transmission, electronic calculations, and communication tools, giving rise to the "digital era" or "digital age," which reflects the importance of digital technologies in the modern world. At the same time, the term "digitalization" is defined as a multifaceted process of transitioning societal sectors to digital technologies [12].

The relevance of this study is determined by the urgent need to improve public administration efficiency amid globalization, technological progress, and evolving citizen expectations. The lack of harmonious digitalization development in Ukraine poses risks to governance stability, national competitiveness, and public trust in authorities. Simultaneously, digital tools open new horizons for enhancing communication, transparency, and accessibility of public services.

Analysis of Recent Studies and Publications Addressing the Problem and Serving as the Author's Basis. In recent years, the issue of digitalization in public administration has been actively researched. Significant attention has been given to both theoretical aspects and practical cases. Theoretical questions about the digitalization of public administration have been explored in the works of V.

Kuibida, O. Karpenko, and V. Namestnik. Researchers such as O. Bernazyuk, V. Birkovych, T. Birkovych, N. Hrytsiak, V. Dreschpak, O. Kabanets, P. Klimushyn, H. Koval, I. Lopushynskyi, I. Makarova, O. Orlov, M. Pavlov, Yu. Piharev, V. Popovych, H. Pocheptsov, V. Rakipov, and others have emphasized the key role of digital technologies in transforming state institutions and analyzed the impact of digital platforms on the efficiency of administrative services. Specific studies by P. Polovyi, H. Razumey, M. Razumey, and others have focused on the modernization of public administration and the benefits of digital technologies in enhancing governmental transparency and citizen participation in decision-making processes. These studies form a foundation for analyzing the opportunities and challenges of digitalization in Ukraine.

At the international level, significant contributions to this topic have been made by researchers such as S. Brennen, M. Kaku, D. Kreis, D. Tapscott, K. Schwab, and A. Williams. European Union experiences and digitalization of public administration in Ukraine have been studied by scholars such as N. Vovk, O. Markovets, V. Pylaieva, and others. Despite the vast body of work on this pressing issue, questions remain unresolved regarding the impact of digital transformation on public administration processes in Ukraine.

Formulation of the Article's Goals (Problem Definition). The goal of this article is to conduct a comprehensive analysis of the impact of digital transformations on public administration, particularly within a contemporary society characterized by the dynamic development of information technologies. It also aims to identify the opportunities presented by digital technologies for public administration, as well as the challenges and barriers encountered during their implementation.

Presentation of the Core Research Material with Justification of Scientific Findings. Digitalization of public administration in Ukraine is a complex and multifaceted process requiring the integration of cutting-edge technologies across all areas of state operations. This process is closely tied to the aspiration to enhance transparency, efficiency, and accessibility of government services [2]. The changes brought about by digital transformation affect every stage of citizen and business interaction with the state. However, this path is not without challenges that require an integrated approach to solving.

Digitalization is changing fundamental aspects of public administration, offering new models of interaction between government, business and citizens. Electronic services allow to reduce the time and costs of administration, providing citizens with easier access to public services. By moving to digital platforms, Ukraine is modernizing the system of public administration, which has historically been burdened by bureaucratic processes. One of the key possibilities of digitalization is the improvement of the efficiency of the state apparatus. Due to the implementation of electronic platforms of such initiatives as, for example, the "Diia" platform, which is an example of how digitalization can reduce barriers between citizens and state institutions, the process of providing administrative services is significantly accelerated. Ukraine became one of the first countries in the world to introduce

digital passports, and the «Diia» platform is a vivid example of innovation in the provision of public services.

The digital transformation agenda spans multiple sectors, including healthcare, education and social protection. In fact, three out of five Ukrainian adults use electronic government services during the year [4;5]. Citizens can access documents, register or submit applications without the need to physically visit government institutions. This not only reduces time spent, but also optimizes the use of public resources, reducing the number of necessary paper documents and reducing the burden on public officials [4;5].

At the same time, digitalization contributes to increasing the transparency of management through open access to information. Digital platforms allow citizens to monitor the activities of government structures by submitting requests and initiating public discussions. This reduces corruption risks and increases trust in the authorities. Thanks to the automation of many routine processes, such as submitting applications, obtaining certificates or registering a business, the time citizens spend interacting with government agencies is significantly reduced. This not only makes life easier for citizens, but also reduces the burden on the state apparatus, freeing up resources for solving strategic tasks. In order to solve this range of problems, it is necessary to encourage employees to actively use digital technologies, increase the level of computer literacy, ensure active participation in seminars and webinars that should be held regularly in the public sector of organizations, form the so-called digital maturity among employees and users. In addition, national programs aimed at supporting and developing the infrastructure of Ukrainian society in general should be developed at the state level [9].

Another important aspect is increasing the transparency of management processes. The use of technologies such as blockchain ensures the immutability and security of data, which makes it impossible to falsify information or corrupt manipulations. For example, in the field of public procurement, the Prozorro system is already in place, which demonstrates how digital technologies can contribute to the fight against corruption and ensure transparency in the spending of public funds.

Ukraine can introduce a blockchain-based electronic voting system. Such a system will provide:

1. Transparency of the election process. All actions in the system are recorded, making them available for inspection.

2. Security guarantee. Voter data and voting results cannot be falsified or tampered with without traces.

3. Availability. Elections can be held online, which simplifies the voting process for citizens abroad or in remote regions.

The use of blockchain in the field of health care will contribute to the creation of a single register of medical records of citizens, protected from changes or loss. This will simplify patient access to medical services, increase diagnostic accuracy and optimize health care costs. Digital transformation, as one of the key trends in the development of human civilization, contributes to the creation of a more inclusive society and the improvement of governance mechanisms. It expands

access to services in the field of health care, education and banking, improves the quality and availability of public services, expands opportunities for interpersonal cooperation, and also opens opportunities to obtain various goods at more affordable prices [13].

The integration of the latest technologies, such as blockchain and artificial intelligence, into public administration ensures transparency, efficiency and security. The development of cyber security is becoming a necessary condition for the protection of government systems and the implementation of digital initiatives. For example:

- Artificial intelligence is used to detect threats in real time by analyzing anomalies in network traffic or user behavior.
- Blockchain can ensure secure data exchange between government agencies, reducing the risks of information leakage.

With the increasing use of digital technologies in governance, cyber security is becoming a critical aspect, especially in the context of war and the rise of cyber threats. The vulnerability of government systems to attacks can lead to the leakage of personal data, disruptions in the work of critical services, or even the loss of sovereignty in the information space.

Further implementation of artificial intelligence, blockchain and big data technologies is expected in the near future. This will allow Ukraine to integrate into the global digital space and ensure sustainable development.

Digitization significantly expands access to administrative services for citizens. In conditions where a large part of the population lives in remote regions or faces difficulties in accessing government institutions, online services eliminate geographical and time barriers. This creates the conditions for greater social equality, in particular for people with disabilities or people living abroad.

In addition, digital transformations are changing the approach to management decision-making. The use of big data technologies allows the state to analyze huge volumes of information to identify trends and forecast the development of situations in various areas. This, in turn, contributes to the development of more effective and adapted policies that take into account the real needs of society.

Another promising direction is the creation of conditions for more active participation of citizens in management processes. Thanks to digital platforms, people can join e-petitions, participate in public discussions or vote for projects to be implemented at the local level. This not only strengthens the democratization of management processes, but also contributes to the formation of trust between the state and citizens.

It is also important to note the economic effect of digitization. Automation of processes, reduction of costs for state apparatus maintenance and creation of transparent conditions for doing business increase the country's investment attractiveness. In particular, simplifying business registration or obtaining permits in digital form reduces administrative barriers for entrepreneurs, contributing to the development of the business environment. According to V. Logvinova, Ukraine has

weaknesses in attracting investments in projects of new knowledge, training of qualified scientific and technical personnel. Conditions of low efficiency of the national innovation system lead to the loss of the country's competitive potential: personnel, technologies and promising ideas [7].

Finally, digitization opens up opportunities for Ukraine's integration into the global digital space. The use of innovative technologies, such as artificial intelligence, allows Ukraine to compete at the international level and attract foreign partners. In addition, the exchange of experience with leading countries in the field of digital transformations contributes to the acceleration of the development of own technologies and the creation of unique solutions that can be exported.

In addition, artificial intelligence and big data technologies are becoming powerful tools for decision-making based on the analysis of large amounts of information. For example, the analysis of socio-economic data makes it possible to forecast the dynamics of the labor market, effectively plan social programs, or even predict the consequences of natural disasters. The use of these technologies also ensures the objectivity and accuracy of management decisions, which reduces the risk of subjectivity and errors.

Digitization radically changes the basic principles of public administration, making it more transparent, accessible and efficient. At the heart of these changes is the interconnected improvement of key aspects such as streamlining processes, increasing transparency, and expanding public participation, which together create a new model of interaction between the state and society.

Optimization of processes in public administration thanks to the implementation of digital technologies ensures automation of routine functions, reduction of time for data processing and minimization of the human factor. Electronic document management, for example, makes it possible to significantly simplify administration, reduce the cost of paper resources and increase the efficiency of government bodies. This becomes the basis for a faster response to the needs of citizens and the creation of prerequisites for the development of other digital tools.

At the same time, digitalization contributes to increasing the transparency of public administration. Thanks to digital platforms, citizens get access to up-to-date information about the activities of authorities, including financial reports, tenders or management decision-making. Such openness not only reduces corruption risks, but also increases trust in state structures, forming a new culture of responsibility and accountability.

Together with transparency, opportunities for citizens to participate in decision-making are expanding. Platforms for electronic petitions, online consultations and public debates allow people to directly influence key aspects of public policy. This not only provides feedback between society and government, but also makes governance more open, inclusive and democratic.

Thus, optimization of processes, transparency and public participation form an interdependent system that forms new standards of public management. Thanks

to digitalization, these aspects reinforce each other, contributing to the creation of a state that is more efficient, fair and focused on the needs of its citizens.

Digitization of public administration opens wide prospects for Ukraine, changing the traditional approach to interaction between the state and citizens. This process involves the creation of a more efficient, transparent and adaptive state apparatus. In this context, digital technologies are not only a tool for automating processes, but also a basis for deep transformations in the management system.

Thus, digitalization of public administration in Ukraine is a powerful tool for modernizing the state apparatus, ensuring social justice and sustainable economic development. However, the effective implementation of these opportunities depends on the ability to overcome existing challenges, including issues of cybersecurity, digital inequality and legal support.

At the same time, digitalization not only optimizes processes, but also stimulates wider participation of citizens in decision-making. E-democracy platforms, such as e-petitions or public budgets, allow citizens to influence the allocation of resources or propose their initiatives. This not only contributes to the growth of civic activity, but also helps the state to take into account the real needs of society.

According to the UN Global e-Government Index (2022), Ukraine has improved its position thanks to active work on the expansion of digital services. Despite the successes in the implementation of digital technologies, Ukraine still has significant challenges to overcome. Uneven access to digital services remains one of the biggest barriers. In particular, the imperfection of the legal framework, insufficient funding and the low level of digital literacy among the population hinder the effective implementation of digital transformations. While big cities enjoy the benefits of digitization, rural areas are often left out of these processes due to lack of access to high-speed Internet. This creates a digital divide that can exacerbate social disparities. Analyzing the research of P. According to Field, it is expedient to define the system of elements of the development of e-government as a system of interconnected mechanisms of security of the information space, electronic interaction, provision of electronic services, electronic democracy and electronic governance [8]. Attracting international experience allows Ukraine not only to avoid typical mistakes, but also to integrate into global digital processes, strengthening its competitiveness in the globalized world. This comprehensive approach is the key to successful digital transformation of public administration in Ukraine.

The possibilities of digitization in Ukraine are closely intertwined with the challenges that stand in its way.

Cyber security is also an important challenge. Cyberattacks on government systems, such as incidents related to the spread of viruses or attempts to access sensitive data, highlight the need to strengthen the protection of government infrastructure. Ukraine needs a modern system for monitoring threats and responding to them in real time, which will ensure the stability of key services.

Personnel training is an equally important problem. The insufficient level of digital literacy among civil servants and the low percentage of qualified IT specialists in regional institutions slow down the implementation of digital solutions. At the same

time, the outflow of specialists abroad complicates the task of forming a stable personnel base. Digitization requires retraining of personnel and changes in approaches to the performance of work duties. This is often met with resistance caused by reluctance to leave the comfort zone of traditional work methods.

For example, the automation of administrative processes creates prerequisites for reducing corruption, but at the same time puts high demands on cyber security, as automated systems become an attractive target for attackers. The development of platforms for citizen participation contributes to the democratization of management processes, but without proper digital literacy, a large part of citizens will not be able to use these tools.

Digital transformations deeply affect public administration, changing its approaches, structure and mechanisms. One of the key aspects is the development of e-government, which is becoming an integrated platform for the provision of public services. Thanks to this, the state can optimize the costs of maintaining institutions and at the same time increase their efficiency. Electronic government not only simplifies citizens' access to services, but also creates conditions for more transparent and structured management.

At the same time, digitalization opens up new opportunities for the democratization of management processes. Tools of e-democracy, such as petitions, e-voting or online consultations, allow citizens to directly influence decision-making. This not only contributes to the involvement of a wider range of participants in the discussion of state policy, but also forms a culture of open dialogue between society and the state. This approach makes management processes more flexible and adaptive to the needs of citizens. The transparency provided by digital technologies is also becoming a powerful tool in the fight against corruption. The use of technologies such as blockchain ensures the immutability of records in public registers and makes corruption schemes almost impossible. Other digital solutions, such as open databases or electronic platforms for public procurement, create the conditions under which citizens can monitor government activities, minimizing the risks of abuse.

At the same time, digitalization stimulates economic development, increasing the country's investment attractiveness. Automating bureaucratic procedures, such as registering businesses or obtaining permits, reduces administrative costs, shortens transaction time, and simplifies doing business. This creates a favorable climate for entrepreneurs, which stimulates both the development of the domestic market and the attraction of foreign investments.

Therefore, the development of e-government, the democratization of management, the fight against corruption and the improvement of the investment climate are closely related to each other in the context of digital transformations. Together, these processes form a new model of public administration, which is more efficient, transparent and oriented to the needs of society.

Digitization creates new challenges in the field of data protection. Vulnerability of information systems can cause leakage of confidential information. In addition, the gap between urban centers and rural regions exacerbates the digital

divide. The COVID-19 pandemic and the war with Russia have revealed the importance of cyber security in the context of public administration.

Ukraine has significant potential for the further development of digitalization. Among the prospects are the creation of a single digital environment, the integration of artificial intelligence in decision-making, the development of infrastructure for data exchange between various state institutions. The successful implementation of these measures depends on the availability of qualified personnel, sufficient funding and stable regulatory and legal regulation.

Overcoming these challenges and realizing the potential of digitalization requires a coordinated strategy. Investing in the development of infrastructure, expanding access to the Internet in the regions, training personnel, and strengthening cyber defense systems are top priorities.

Ukraine should also continue the integration of international experience, taking into account the successful practices of countries that have made significant progress in digitalization and are implementing digital technologies in management. For example:

• Estonia. This country is a world leader in the digitization of the public sector, offering e-residency, online voting in elections and a fully digital document flow.

• Singapore. Through the use of artificial intelligence and automation, Singapore has achieved a high level of efficiency in the management of transport, medicine and the provision of administrative services.

• EU countries. European initiatives such as the Digital Europe program aim to develop digital skills, secure infrastructure and innovation in the public sector.

As you know, Great Britain was among the leaders in implementing digital tools and solutions in the work of government bodies and set an example for many other EU countries in this direction. The use of information technologies in public administration made it possible to improve access to public services, reduce bureaucratic barriers, and contributed to greater involvement of citizens in decision-making processes in government structures. The creation of e-government in Europe began in 2000, when the Lisbon Strategy was developed, which was aimed at increasing the competitiveness and development of the European Union. One of the important components of this strategy was the development of the digital sector and the use of information technologies in the field of public administration, which affected the further development of electronic government in Europe [3].

Finally, it is necessary to continue researching the international experience of ensuring information security in such areas as: development of international standards and normative acts; development of international partnership and participation in various international initiatives [10].

The advantages of international cooperation are as follows:

1. Adaptation of best practices. Ukraine can borrow effective models of digitization, taking into account its own characteristics.

2. Access to resources. Participation in international projects makes it possible to attract financing for the implementation of digital technologies.

3. Development of partnership relations. Joint initiatives contribute to Ukraine's integration into the global digital space.

Ultimately, digitalization should become a tool not only for optimizing existing processes, but also for rethinking approaches to public administration. Only in this case, the state will be able to take advantage of all the advantages of digital transformation, creating an efficient, transparent and accessible management system.

Digitization not only changes the ways of governance, but can also contribute to greater social justice. For example: ensuring equal access to public services through online platforms, especially for residents of remote regions or people with disabilities; reduction of barriers for interaction between citizens and the state thanks to electronic forms of communication.

Attention to digitalization should be paid not only at the level of the central government, but also at the level of local self-government. The use of technology in communities can significantly increase their development potential, contributing to economic growth.

Geopolitical and security factors also affect digitalization in Ukraine. In the conditions of military operations, it is especially important to ensure the uninterrupted operation of digital systems, the protection of state databases and the development of backup systems. It is necessary to implement systems of regular monitoring and evaluation of the effectiveness of digital initiatives in order to timely adapt strategies to new challenges.

Conclusions. Digitalization is an important factor in the transformation of public administration in Ukraine and is a necessary condition for modernizing the state, increasing its competitiveness, and adapting to global challenges. Digitization is a powerful tool for reforming public administration in Ukraine and a strategic process that is crucial for the transformation of public administration, strengthening democracy and ensuring sustainable development. It opens up new opportunities for increasing the efficiency, transparency and accessibility of public services. At the same time, the success of this process depends on the state's ability to overcome existing challenges, such as uneven technological development, cyber threats, regulatory gaps and insufficient training of personnel, financial limitations. In addition, there is a need to ensure citizens' trust in digital services. Digitization is an important tool for strengthening anti-corruption policy, stimulating economic growth and attracting investment. However, its implementation is accompanied by significant challenges, such as technical vulnerabilities, regulatory constraints and digital inequality. A comprehensive approach to solving these problems will ensure the sustainability of digital transformations and a positive impact on the lives of citizens.

Ukraine is making significant progress in the implementation of e-government, but to achieve sustainable results, it is necessary to focus on long-term strategic goals. This includes increasing international cooperation, developing digital infrastructure, implementing innovative technologies such as artificial intelligence and blockchain, as well as ensuring data security and user privacy.

In general, digitalization in public administration is not only a technological update, but also a fundamental change in the relationship between the state, society

and business. It forms a new management model based on the principles of transparency, openness, efficiency and orientation to the needs of citizens. The successful implementation of this model requires an integrated approach, effective interaction of all stakeholders and a sustained commitment to modernization, which must be based on the best international practices and meet national needs.

Prospects for further research include the study of the impact of digital innovations on economic development, the development of mechanisms for the integration of technologies into public administration, and the analysis of social aspects of digitalization. Ukraine has a unique chance to take advantage of the opportunities of digital transformation to strengthen its statehood and integration into the global digital space.

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ARTIFICIAL INTELLIGENCE AND POLITICAL RIGHTS: CHALLENGES AND PROSPECTS FOR UKRAINE

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Abstract. The article "Artificial Intelligence and political rights: challenges and prospects for Ukraine" explores the intersection of AI and political freedoms, highlighting both opportunities and challenges posed by the integration of artificial intelligence in political processes. It emphasizes the importance of ensuring the protection of fundamental human rights amidst the rapid digital transformation.

The authors analyze how AI technologies can enhance the transparency, efficiency, and inclusiveness of political systems, particularly in voting and public administration. They also stress the necessity of robust legal frameworks to address privacy concerns, data protection, and the ethical use of AI in political campaigns and governance. Moreover, the article discusses the implications of using AI in electoral systems, referencing international practices and lessons that Ukraine can adopt.

Key challenges include preventing data misuse (as seen in cases like Cambridge Analytica), addressing disinformation, and safeguarding against cyber threats. The authors propose adopting international legal standards, such as the General Data Protection Regulation (GDPR), and developing domestic legislation tailored to the Ukrainian context to balance innovation with the protection of political freedoms. In summary, the article advocates for a nuanced approach to AI integration, where technological advancements are aligned with democratic principles and human rights. It positions Ukraine as a potential leader in leveraging AI responsibly within its political framework.

Keywords: Artificial Intelligence, Political Rights, Electoral Process, Democratic Freedoms, Digital Technologies, AI Ethics, Data Privacy, Cybersecurity, Electronic Voting, AI Regulation, Disinformation, Digital Transformation, Political Participation.

In the modern world, digitalization has become an integral part of political life, offering both new opportunities and threats to the realization of political rights and freedoms. Digital technologies enable citizens to actively engage in political processes through online platforms, social networks, electronic voting, and access to open government data. However, these advancements are accompanied by challenges that require regulation and the safeguarding of fundamental rights.

The digitalization process profoundly impacts political rights and freedoms, creating both new opportunities for their realization and significant challenges. This particularly involves the protection of personal data, combating disinformation, ensuring the cybersecurity of electoral processes, and guaranteeing equal access to political information. Artificial intelligence (AI) allows for the near-complete elimination of the human factor in securing information systems, leaving only auxiliary functions such as monitoring and corrections. In this context, AI is a technology of the future. AI and its related technologies are opening new horizons in the digital age and are being actively employed in both civil and military spheres. According to expert forecasts, the implementation of such solutions is expected to contribute $1 trillion to global economic growth in 2024 [1, c.52].

The development of artificial intelligence (AI) technology is leading to changes in the status of individuals in society, making it imperative that its application respects fundamental human and citizen rights, particularly labor rights, due to the "substitution effect." This dynamic introduces social issues and challenges related to the realization of certain rights and freedoms. Consequently, the use of AI technologies in socio-economic and administrative spheres must be approached with caution and subject to oversight by civil society and government authorities.

This necessity raises the question of legal regulation of these processes in Ukraine, where national legislation must adapt to the challenges of the digital age. Ukraine's integration into the European community, particularly its affiliation with the Council of Europe, underscores the country's commitment to a series of international legal obligations, primarily the respect for and protection of human rights. Among the commitments undertaken before the Council of Europe, a cornerstone was Ukraine's ratification of the Convention for the Protection of Human Rights and Fundamental Freedoms in 1997 [2] and the associated recognition of the jurisdiction of the European Court of Human Rights. Issues related to the use of artificial intelligence (AI) must be regulated in accordance with the norms of international treaties and conventions ratified by the majority of European states. Specifically, this includes specialized international agreements in the field of AI development, such as the Council of Europe Convention on Cybercrime, commonly known as the Budapest Convention [3]; the European Ethical Charter on the Use of Artificial Intelligence in Judicial Systems and their Environment, as well as the General Data Protection Regulation (GDPR) [4].

The increasing volume of personal data processing poses significant threats to political rights and freedoms. Modern technologies enable the collection of vast amounts of information about citizens, including their political preferences, which are often utilized for targeted political advertising. For instance, during election campaigns, political parties leverage social media data for microtargeting, potentially distorting voters' free choice and influencing their political decisions.

On the other hand, insufficient attention to the protection of such data may lead to leaks or abuses, as was evident in the Cambridge Analytica scandal, where the data of millions of Facebook users were exploited to manipulate voters in the United States and the United Kingdom. Consequently, one of the primary challenges

of digitizing political processes is ensuring robust protection of citizens' personal data and preventing unauthorized use.

Digital technologies can also be employed to restrict political rights and freedoms through censorship and information control. Some governments use cybersecurity laws or anti-disinformation measures as tools to limit freedom of expression and access to information. For example, in countries like China and Russia, digital technologies are utilized to block opposition websites, social media platforms, or other channels where citizens can voice criticism of the authorities. Such restrictions undermine the principles of democratic society and facilitate the establishment of authoritarian regimes that leverage digital tools to exert control over their populations.

According to the provisions of current legislation, artificial intelligence (AI) is defined as an organized set of information technologies that enable the execution of complex and multifaceted tasks through the application of a system of scientific research methods and algorithms for processing information obtained or independently generated during operation. Furthermore, AI systems are capable of creating and utilizing their own knowledge bases, decision-making models, information processing algorithms, and determining methods for achieving predefined objectives [1, c.57].

At the same time, alongside the evident advantages of integrating AI technologies into all spheres of societal life, it is crucial to consider the potential threats and challenges to the realization of human rights and freedoms. In August 2012, philosophy professor Hugh Price published an article titled «Artificial Intelligence: Can We Keep It in the Box?» in which he urged serious consideration of possible risks associated with AI. Price argued that the first prudent step is to cease treating artificial intelligence as a subject of science fiction and start viewing it as a tangible reality that we or our descendants may inevitably confront.

The primary source of danger, according to Price, lies in the fundamental difference between anticipated artificial intelligence and human intelligence. Values such as "love, happiness, and even survival" are significant to us because of our evolutionary history. However, there is no reason to assume that machines will share these values with us. As Price suggests, machines may simply be indifferent to humanity, a scenario that could lead to catastrophic consequences [5].

The utilization of artificial intelligence (AI) raises critical concerns regarding human rights enshrined in international legal frameworks, such as the right to respect for private and family life, freedom of expression, non-discrimination, freedom of movement, the right to free and fair elections, and the right to a fair trial.

Ukraine is actively participating in the global process of improving the legal regulation of AI technologies and aspires to occupy a significant segment of the global AI market, aiming for leading positions in international rankings. The country has already started leveraging the experience of advanced European nations, such as Estonia, in its journey towards building an "electronic Ukraine." A notable milestone in this endeavor was the approval of the Concept of Artificial Intelligence Development in December 2020.

This strategic document aims to foster the integration of innovative AI technologies into key economic sectors, enhance public administration systems, and transform Ukrainian society in the context of the digital era. It outlines the priority areas and fundamental tasks for AI development in the country, focusing on creating a competitive national economy, improving public management, and ensuring the protection of individual rights and legitimate interests [6], the practical implementation of this Concept is expected to facilitate the integration of innovative technologies into economically significant sectors of the state. Artificial intelligence (AI) technologies are anticipated to drive the transformation of the economy, labor market, public institutions, and society as a whole. Their application is projected to reduce costs, enhance production efficiency, and improve the quality of goods and services.

The primary goal of the Concept is to identify priority directions and key tasks for the development of AI technologies, aiming to safeguard the rights and legitimate interests of individuals and legal entities, build a competitive national economy, and optimize public administration systems. The policy focuses on strategically important areas, including education and professional training, science, the economy, cybersecurity, information security, defense, public administration, legal regulation and ethics, and justice.

By targeting these priority sectors, the Ukrainian government seeks to establish an innovative and secure AI ecosystem that promotes national competitiveness while addressing both opportunities and challenges posed by emerging digital technologies [6].

Special attention in the provisions of the Concept is devoted to the development of artificial intelligence (AI) specifically in the field of cybersecurity. Ukraine's current legislation establishes that the primary task in the sphere of cybersecurity, as part of the implementation of state policy on AI development, is the protection of communication, information, and technological systems. This includes information technologies, particularly those used by operators (providers) of key services, including critical infrastructure objects that are essential for the continuous functioning of the state, society, and the safety of its citizens.

For a long time, Ukraine lacked legislation to regulate security issues in both the informational and cyber domains. The first attempt to address this gap was the draft Law of Ukraine "On the Fundamentals of Information Security of Ukraine," which proposed distinguishing between information security and cybersecurity. This distinction aimed to ensure that legal and regulatory frameworks address the unique challenges posed by each domain, while also providing comprehensive protection mechanisms in response to the increasing threats associated with digital transformation and the proliferation of advanced technologies.

By advancing legislative initiatives in cybersecurity, Ukraine demonstrates its commitment to creating a robust infrastructure capable of mitigating cyber threats, safeguarding critical assets, and securing the nation's integration into the global digital ecosystem. The continued development and refinement of such policies are vital to protecting citizens' rights and maintaining national security in the digital age [7]. Thus, the primary requirement is that collected personal data

must be adequately protected. Personal data should be gathered, used, and shared only with the knowledge and consent of the individual. Additionally, individuals must have access to their collected personal data, including the ability to correct or delete inaccurate information.

Presidential Decree No. 685/2021 enacted the decision of the National Security and Defense Council of Ukraine dated October 15, 2021, "On the Strategy for Information Security." This strategy outlines key concepts in the field of information security and provides an analysis of the primary threats and challenges in this domain. The document serves as a framework for addressing risks associated with data protection, cyber threats, and the integrity of information systems, emphasizing the importance of robust security measures to safeguard personal information and ensure public trust in the digital environment [8].

The Strategy explicitly emphasizes that the lack of an adequate level of information culture and media literacy within society, particularly during the rapid development of digital technologies, provides fertile ground for manipulating public opinion and conducting swift destructive information operations. This reality creates both potential and actual threats to Ukraine's information security. Therefore, the ability to analyze information from various sources and access reliable online resources becomes a critical component in countering disinformation, particularly from the Russian Federation, during the state of war in Ukraine.

In our view, the use of artificial intelligence (AI) technologies must prioritize the protection of human dignity as a fundamental and foundational human right upon which all other rights and freedoms are based. Any violation of human rights through the misuse of AI can thus be considered a violation of the right to human dignity. The deployment of AI technologies significantly alters the structure of human relationships, including legal relations, creating a new "human-machine" paradigm. This development impacts private law by necessitating a balanced legal framework for regulating the legal status of robots equipped with AI. It also raises the issue of holding these entities accountable for harm caused by their actions, as well as safeguarding intellectual property rights for creations generated by such robots.

The integration of AI technologies across all spheres of human life must prioritize safety, respect for human rights, and the intrinsic value of human dignity. A major issue stemming from AI usage today involves the infringement of human rights related to the confidentiality of private data on the Internet and interference in personal and private life.

Given the need for universal rules governing the use of AI technologies worldwide, especially in countries with varying levels of socio-economic development, it is essential to adhere to the principle of universality of human rights and the inviolability of fundamental human values. A key characteristic of universal rights is their inalienability and their restriction only under exceptional circumstances. According to the preamble of the European Convention on Human Rights, the effective guarantee of fundamental rights and freedoms is best achieved "through an effective political democracy." Article 3 of Protocol No. 1 of the Convention reinforces this by ensuring the mediation of freely elected

representatives and the right to vote and be elected in genuine periodic elections conducted based on universal and equal suffrage by secret ballot. These elections must safeguard the freedom of voters to express their will without undue influence.

This comprehensive approach underscores the importance of both legal and ethical considerations in the use of AI technologies to ensure their alignment with human dignity, rights, and democratic principles [9].

According to Article 25 of the International Covenant on Civil and Political Rights, every citizen, without discrimination or unreasonable restrictions, must have the right and opportunity to participate in public affairs directly or through freely chosen representatives. The European Court of Human Rights has elaborated on the application of this principle, emphasizing that holding elections at reasonable intervals is crucial for a genuinely democratic society, as the preservation of fundamental human rights and freedoms fundamentally relies on democracy. These conditions, according to the Court, include freedom of expression, as protected by Article 10 of the European Convention on Human Rights, as well as the principle of equality in granting all citizens the right to vote (active electoral rights) and the right to stand for election (passive electoral rights).

One of the key advantages of artificial intelligence (AI) is its potential to optimize electoral processes. AI integration enables the automation of various procedures, such as voter registration, vote counting, monitoring of violations, and the prevention of fraud. For instance, AI algorithms can analyze large datasets to detect anomalies, thereby enhancing the transparency and trustworthiness of electoral processes. Furthermore, AI application in political communication fosters greater public engagement in elections by increasing awareness about elections, candidates, and their platforms.

In Ukraine, the use of AI technologies in electoral processes remains at a developmental stage and requires legislative formalization. In contrast, many other countries have already embraced AI in electoral systems, particularly for electronic voting and rapid result processing. Currently, electronic voting systems are implemented in several countries, including the United States, Canada, Brazil, India, Belgium, Australia, Estonia, and South Korea. Experiments with such systems are also underway in countries like the United Kingdom, Germany, France, Spain, Portugal, Italy, Norway, Switzerland, Kazakhstan, Japan, and China.

In these countries, AI technologies in elections have demonstrated the potential to streamline processes and reduce inefficiencies, but their application also highlights the need for robust cybersecurity measures, transparency, and accountability. Ukraine, as it continues its journey toward digital transformation, has the opportunity to learn from international experiences to implement AI in its electoral processes effectively, ensuring both technological advancement and adherence to democratic principles [10].

For the Ukrainian electoral system, "electronic voting" is an entirely new and unfamiliar phenomenon, requiring a clear understanding of its essential characteristics. Electronic voting encompasses several different types of voting mechanisms. It includes

both the process of casting votes using electronic means and the automatic counting of votes through electronic devices and specialized software [12].

In Europe, voting equipment was first introduced in the Netherlands in 1969. By the early 1990s, the Ministry of the Interior implemented electronic voting systems, significantly modernizing the electoral process. By the year 2000, nearly 90% of voters were using electronic voting equipment.

However, due to growing concerns from critics about the transparency and security of electronic voting systems, the Netherlands reverted to traditional paper ballots during the 2008 elections. This decision highlighted the challenges and skepticism surrounding the use of electronic voting technologies, including issues of voter confidence, potential vulnerabilities to cyber threats, and the lack of robust auditing mechanisms.

In Estonia, electronic voting has been used for local elections since 2005 and for parliamentary elections since 2007. During the 2007 parliamentary elections, 30,275 citizens cast their votes online without leaving their homes. This marked a significant milestone in digital democracy, showcasing Estonia's leadership in leveraging technology for electoral processes [13].

In 2002, Estonia introduced electronic signatures and digital ID cards equipped with a code and microchip. These cards store visual data and two digital certificates, enabling user identity verification and secure digital signatures. [14, 15]. Today, the majority of eligible voters in Estonia possess these digital ID cards, facilitating widespread adoption of electronic voting and other e-government services. The system has earned international recognition for its efficiency and ability to ensure voter security and anonymity [16].

In the United States, voting technology has similarly undergone significant modernization. Traditional punch cards have largely been replaced by electronic voting machines equipped with touchscreen systems. Voters can make their choices by simply tapping the screen, streamlining the voting process. This system has been implemented in voting districts across 42 out of 50 states, representing a substantial technological shift [17]. The deployment of these touchscreen voting machines cost approximately $4 billion, reflecting the significant investment required for electoral modernization. However, the adoption of such systems has also sparked discussions regarding transparency, security, and trust in electronic voting.

In Switzerland, a country of referendums, about 90% of voters prefer the traditional voting method. The electronic voting system "E-Voting" is being implemented as part of the strategic project "Vote électronique." The first trial of electronic voting took place in 2003 during municipal elections in the canton of Geneva. In 2005, similar pilot projects were carried out in the cantons of Neuchâtel and Zurich. Today, this system partially covers voters in 13 out of 26 cantons. According to experts, the further expansion of electronic voting will require the authorities to urgently implement second-generation software that will enable unequivocal voter authentication/verification. The strategic perspective of Swiss democracy is the further development of Internet technologies for the direct participation of citizens in state governance [18].

Ukraine is still taking its first steps toward implementing an electronic voting system. At the legislative level, an adequate framework for this has not yet been established. Member of Parliament O.I. Tyshchenko submitted a draft resolution to the Verkhovna Rada on the introduction of "electronic voting," which aims to ensure transparency in the interaction between the government and Ukrainian citizens, but the project has not yet been implemented. Since 2002, the Central Election Commission has operated the Unified Information and Analytical System "Elections" in one form or another, designed to quickly determine preliminary voting results [12].

The National Ministry of Digital Transformation implemented a pilot project with PrivatBank's Smart-ID. This involves identification using an electronic signature stored not on a chip but on a SIM card. Thus, each individual can easily obtain an identification tool. This innovation represents another step toward the introduction of an electronic voting system. However, the signature on a smartphone is insufficiently protected against hacking.

From the perspective of ensuring human rights, particularly the right to fair and transparent elections, the following drawbacks should be noted:

- electronic voting cannot guarantee full protection against fraud through interference by interested parties in the system's operation;
- additionally, there is a risk of data leakage and a breach of the right to voting secrecy;
- the transparency and reliability of technological solutions for this type of voting will always remain a significant concern, leading to distrust in the voting results;
- the greatest disadvantage of implementing an electronic voting system in the context of modern Ukraine, given the ongoing hybrid aggression, is the potential for cyberattacks on the system, particularly from the aggressor country.

Since 2015, Ukraine has successfully implemented an «electronic petitions» system, enabling citizens to address government authorities, submit complaints, or make proposals. An electronic petition is one of the tools of e-democracy. According to the Law of Ukraine «On Citizens' Appeals», a petition is a specific form of collective appeal by citizens, including suggestions (comments), applications (requests), and complaints, presented in written or oral form. The first petition to gain the required number of votes was submitted by the Association of Gun Owners of Ukraine, which demanded the legislative establishment of the right of Ukrainian citizens to self-defense. During the processing of signature data, so-called «bots» were detected, attempting to inflate the number of signatures. Studies indicate that in 2018, more than 1,000 consultations were provided via electronic applications [20].

Currently, citizens can submit electronic petitions on the official websites of the President of Ukraine, the Verkhovna Rada of Ukraine, the Cabinet of Ministers of Ukraine, and local government authorities.

The digitization of political processes creates new opportunities for engaging citizens in political life while posing significant challenges to the protection of political rights and freedoms. Ukrainian legislation requires further adaptation to

the emerging realities, particularly in the areas of personal data protection, cybersecurity, and combating disinformation. Achieving a balance between freedom of speech and the need to protect national security while adhering to democratic principles is critical. Ensuring the balance between freedom of expression and the necessity to safeguard national security and state interests is especially vital. Governments and international organizations must enhance mechanisms to protect political rights and freedoms in the digital age, avoiding the creation of systems that violate fundamental principles of democracy and human rights.

The digitization of political processes in Ukraine reflects broader global trends while simultaneously introducing challenges related to the protection of political rights and freedoms. Despite existing legal frameworks, Ukrainian legislation exhibits significant gaps that impede the effective regulation of digital aspects of political life.

Insufficient protection of personal data. The Law of Ukraine «On Personal Data Protection» provides basic requirements for the processing and storage of data but does not address the specificities of modern digitization. For instance, the absence of clear regulations on the use of personal data during political campaigns (such as microtargeting and citizen data analysis) creates opportunities for abuse, similar to the Cambridge Analytica case. Improving mechanisms for personal data protection by adopting international standards such as GDPR and establishing clear rules for political entities' use of voters' personal data is essential.

Insufficient cybersecurity of the electoral process. Despite the existence of the Law «On the Basic Principles of Cybersecurity», the protection level of electoral infrastructure remains inadequate. Cyberattacks on the Central Election Commission during elections highlight the urgent need to strengthen protective measures and adopt modern technological solutions. Furthermore, Ukrainian legislation does not yet offer adequate protection for digital platforms used in political campaigns, nor does it provide clear regulation of cybersecurity threats within the electoral process.

Unregulated disinformation. One of the most significant challenges is combating disinformation, which can undermine political processes and influence election outcomes. Legislation on disinformation in Ukraine is still under development, but initiatives such as the draft law "On Disinformation" have sparked considerable controversy. It is crucial to strike a balance between ensuring freedom of speech and combating fake news by creating mechanisms for accountability in spreading disinformation without infringing on citizens' democratic rights.

Gaps in regulating digital rights and freedoms. Ukrainian legislation insufficiently addresses modern digital challenges related to political rights, particularly in the context of online communications, digital platforms, and social networks. Electoral campaigns actively utilize online resources, but their impact on political processes is not yet adequately regulated. For instance, there are no clear mechanisms for controlling the use of political advertising on social media platforms.

While Ukraine is making strides toward integrating international standards into its legislation (including through alignment with GDPR), significant gaps

remain in harmonizing with global requirements. This applies to both the protection of personal data and the safeguarding of privacy rights in the digital space. An analysis of Ukrainian legislation reveals several shortcomings in the face of rapid digitization, necessitating improvements. Among the most pressing challenges are the protection of personal data during elections, combating disinformation, and ensuring the cybersecurity of critical infrastructure.

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APPLICATION OF IMMERSIVE TECHNOLOGIES IN THE AGRICULTURAL SECTOR

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Immersive technologies can be considered as the integration of virtual content with the physical environment, allowing users to interact naturally with mixed reality, which combines two main types of reality: augmented (AR) and virtual (VR) (Arbogast, M., 2019 [1]). On the other hand, immersive technologies include methods and devices that create the effect of immersion in a virtual world through sensory stimuli, using simulation and mapping. This allows people to experience realistic experiences that are not always available in the real world. such technology is the combination of the real environment with digital tools through interactive actions.

Virtual reality (VR) is a technology that creates three-dimensional virtual worlds in which the user interacts with objects and feels a three-dimensional presence. Augmented reality (AR) is an interactive computer visualization technology that adds virtual objects to the real world, allowing users to see and interact with them in real time using mobile devices, applications, and web browsers. The difference between AR and VR is that augmented reality "extends" the real world, while VR "transports" the user to another location.

A modern innovative educational environment can be called a virtual environment associated with current digital technologies, which is actively implemented in education, is virtual reality (VR). It is characterized as an immersive,

realistic three-dimensional environment that provides visual feedback, responding to body movements [2].

Modern agriculture actively integrates innovative technologies to increase productivity, reduce costs and preserve the environment. Immersive technologies, such as augmented reality (AR), virtual reality (VR) and mixed reality (MR), have great potential in crop production. They open up new opportunities for effective resource management, training farmers and optimizing crop growing processes.

Artificial intelligence (AI) and big data processing are used to analyze information, recognize objects, detect plant and animal diseases, predict yields, optimize planting plans and other tasks that help agricultural producers make informed decisions and increase management efficiency. Automation and robotics help optimize agricultural processes. For example, autonomous tractors, drones, and robots can do the work of planting, weeding, harvesting, or caring for animals, which significantly increases the accuracy of production operations, efficiency, and reduces human resource costs.

The use of cloud computing and data analytics provides the collection, storage, and analysis of large amounts of data from various sources. This allows farmers to identify trends, predict weather conditions, optimize resource use, and make effective management decisions that contribute to increased productivity.

Mobile applications and platforms provide access to useful information, such as weather forecasts, market conditions, recommendations, legislation, etc., which will help farmers plan and manage production more effectively. Mobile applications and platforms play a key role in the modernization of agriculture, giving farmers access to a variety of useful information. Thus, they provide accurate weather forecasts, which allows farmers to better plan planting and harvesting, as well as to anticipate possible risks, such as droughts or heavy rains. In addition, applications provide information on the state of markets, including product prices, demand and trends, which allows farmers to optimally sell their products and receive maximum profits.

Based on this platform, recommendations are provided for growing various crops, caring for them, using fertilizers and plant protection products, which allows maintaining best practices in production. Information on current legislation is also an important component, as it will allow farmers to stay abreast of changes in regulatory penalties, avoid and work in accordance with the requirements.

Some applications do not have analytics functions that can collect data from sensors, drones or other devices, automate accounting and reporting, and model future farm development scenarios. Thanks to this, farmers can plan production processes more effectively, reduce costs, increase yields, and ensure the sustainable development of their business.

Scientists emphasize that “the digital transformation of the agricultural sector opens up new opportunities for its effective development. It increases production efficiency, product quality, and increases the level of profitability of agriculture. The digitalization process consists of the introduction of modern digital technologies that allow improving the efficiency and quality of agricultural production and optimizing the use of resources in these processes, thereby increasing profitability. " [3, p. 2].

Now is the era of immersive technologies in crop production, which opens up new opportunities for effective resource management and increased productivity. The integration of virtual reality (VR) and augmented reality (AR) technologies into the agribusiness sector has gained significant momentum in developed countries. These technologies are revolutionizing agricultural practices, increasing efficiency, and solving critical problems in the industry.

In countries such as the United States, Germany, and Japan, VR systems are being used to train agricultural workers and students. These simulations allow users to practice planting, caring for crops, and harvesting in a controlled virtual environment. This approach reduces the costs associated with on-site training and minimizes risks by preparing workers for real-world scenarios.

AR and VR are used to simulate key agricultural processes such as planting, irrigation, fertilization, and pest control. By visualizing these operations, farmers can determine optimal methods and strategies to maximize productivity. In the Netherlands, for example, VR technology is being used to develop precise planting patterns, reduce resource waste, and increase yields.

Augmented reality applications allow farmers to analyze the health of their crops and soil conditions in real time. Sensors integrated into AR platforms provide data on soil moisture, acidity, and nutrient content. This allows for precise planting and fertilization decisions, as seen in advanced agricultural systems in Israel.

Countries such as Canada and Australia are using VR to model the impact of climate change on agricultural practices. These models help farmers prepare for extreme weather events such as droughts, floods, or sudden freezes, allowing them to develop adaptive strategies and reduce potential losses.

AR applications provide a safe environment for testing different methods of pest and disease control. In India, AR tools are helping farmers identify pests and diseases early, providing instant treatment recommendations, thereby reducing the need for extensive pesticide use.

In regions like Europe and North America, AR and VR are an integral part of precision farming. These technologies combine data from drones, sensors, and GPS systems to create detailed field maps, allowing for precise application of water, fertilizers, and pesticides. This not only reduces waste, but also supports sustainable agriculture by minimizing environmental impact.

Countries like the UK and France are using augmented and virtual reality to explore scenarios for maximizing productivity while maintaining ecological balance. Farmers are using these technologies to identify the most effective practices for their specific conditions, ensuring higher yields and profitability.

The adoption of AR and VR technologies in agriculture abroad is demonstrating their transformative potential.

Examples of different climate change or man-made scenarios affecting agricultural yields using immersive technologies

- **Simulation of a prolonged drought**

Scenario: A VR environment recreates the effects of a prolonged drought on crop growth over multiple cropping cycles.

Objective: To analyze how reduced water availability affects soil health, crop yields, and pest outbreaks.

Outcome: Farmers can test irrigation methods such as drip systems or experiment with drought-tolerant seed varieties in a safe virtual environment.

- **Flood Risk Management**

Scenario: An AR simulation simulates flooding conditions, highlighting areas prone to waterlogging.

Objective: To determine crop resilience in saturated soils and determine optimal drainage solutions.

Outcome: Farmers learn to implement preventative measures such as building dikes or selecting water-tolerant crops.

- **Extreme Temperatures and Heat**

Scenario: A virtual reality application visualizes the effects of sudden temperature changes on photosynthesis and plant productivity.

Objective: To assess which crops perform better under high temperatures and adjust planting schedules accordingly.

Outcome: Farmers develop strategies to mitigate heat stress through shade nets or changing planting dates.

- **Soil Degradation from Chemical Pollution**

Scenario: An immersive VR simulation shows the long-term effects of overuse of fertilizers or pesticides, leading to soil acidity or salinity.

Objective: To experiment with soil restoration methods such as crop rotation, organic amendments, or reducing chemical use.

Outcome: Improved knowledge of sustainable methods to restore soil health.

- **Impact of Pests and Diseases in Climate Change**

Scenario: Augmented reality tools overlay live crop data on visual indicators of potential pest infestations, taking into account climate conditions.

Objective: Predict pest outbreaks under varying temperature and humidity levels.

Outcome: Farmers test biological pest control methods or optimized pesticide applications, minimizing losses.

- **Wildfires and Smoke Pollution**

Scenario: VR model recreates the effects of wildfires, simulating smoke damage to nearby crops and nutrient depletion in the soil.

Objective: Assess recovery periods and effectiveness of transplanting strategies.

Outcome: Farmers gain knowledge about management methods after natural disasters.

- **Man-made spills and accidents**

Scenario: Augmented reality tools simulate scenarios such as oil spills or industrial waste affecting farmland.

Objective: To assess impacts on groundwater and crop security, and to test recovery approaches.

Outcome: To improve preparedness for environmental emergencies.

- **Changing rainfall patterns**

Scenario: VR simulation of erratic rainfall patterns and their impact on the planting, flowering, and harvesting stages.

Objective: To develop adaptive planting schedules and test rainwater harvesting systems.

Outcome: Farmers adjust practices to reduce reliance on unpredictable natural rainfall.

- **Impact of urbanization**

Scenario: VR models demonstrate how urban encroachment reduces arable land, changing microclimates and water availability.

Objective: To explore solutions such as vertical farming or greenhouse technologies in confined environments.

Outcome: To provide insights into maximizing yields in confined spaces.

- **Deteriorating air quality**

Scenario: AR app analyzes plant health under conditions of high levels of atmospheric pollutants, such as increased CO2 or particulate matter.

Objective: Test mitigation measures, such as barriers or air purification plants, and predict the impact on yield.

Outcome: Farmers implement methods to protect crops from air pollution, ensuring sustainable growth.

These technological scenarios enable stakeholders to understand, predict, and adapt to the challenges of climate change and man-made factors, paving the way for sustainable and resilient agricultural practices.

By providing innovative solutions for training, resource management, and sustainability, these tools help farmers overcome traditional challenges and pave the way for a smarter and more efficient agribusiness sector.The use of virtual reality (VR) and augmented reality (AR) technologies allows farmers to receive visualized information about the status of positions, assess the quality of justifications and monitor the moisture level on site in a virtual environment. Immersive platforms allow you to simulate various scenarios of crop development, simulate the impact of climate change or man-made factors on yield, and develop plant protection strategies. At the same time, such technologies facilitate the training of specialists, providing access to interactive training and simulators that help master complex agrotechnical processes.

Immersive technologies also help optimize the use of resources such as water, fertilizers and plant protection products by accurately predicting crop consumption in real time. This reduces costs and negative impacts on the ecosystem, supporting the principles of sustainable development in the agricultural sector.

The mass implementation of immersive technologies in crop production will be the first stage in the transformation of the agricultural industry, ensuring its more innovative, technological and environmentally friendly development.[3]

Immersive technologies are digital tools that create virtual environments or integrate digital elements into the real world, providing users with a new level of interaction.

AR (augmented reality) adds digital information to the real environment through devices such as smartphones or glasses.

VR (virtual reality) creates a completely artificial environment that allows you to simulate different scenarios.

MR (mixed reality) combines elements of AR and VR to interact with real and virtual objects.

Using AR allows farmers to create virtual field maps that contain data on soil characteristics, moisture levels and previous yields. This helps optimize crop placement to maximize yields. Using AR allows farmers to create virtual field maps that integrate data on soil characteristics, moisture levels, yield history and even predicted climate changes. Such maps allow for detailed analysis of the skin area, determining the optimal areas for growing specific crops. This ensures the rational use of fertilizers, use and water resources. Based on the analysis of data from satellites and sensors, farmers can predict problems such as soil erosion or the risk of drought, which further measures are taken to prevent losses.

VR technologies are used to simulate various scenarios in crop production, such as sowing, plant care, or harvesting. This provides safe and effective training without the need for real resources. VR technologies also allow you to simulate the impact of various agronomic factors, such as changing weather conditions, the impact of pests, or a lack of fertilizers. Thanks to this, farmers can analyze the possibilities of risks and work out strategies to overcome them.

In addition, these technologies are used to teach students of agricultural specialties, helping them gain practical experience in a virtual environment. VR systems can create interactive simulations to study the structure of justifications, the features of crop development, or the use of modern agricultural technology.

Thus, VR technologies contribute to increasing the efficiency of agricultural production, reducing costs, and a more environmentally friendly approach to farming. They remain another tool in the development of "smart" farming, which is based on innovation and digital technologies/

Mixed reality can be used to analyze the condition of plants in real time. For example, farmers can use AR glasses to visualize data from sensors installed in the field, such as soil moisture or disease risk.

AR technologies allow the visualization of the process of fertilizer or water application based on data collected from sensors and drones. This contributes to the accurate use of resources, reducing waste and negative impact on the environment.

VR can be used to create simulations of future harvests based on climate data, which helps in sales and logistics planning.

Immersive technologies allow the detection of disease or pest outbreaks through real-time image analysis. AR tools can display affected areas on a map of the field, allowing for rapid response.

Ecological approach to the use of VR technologies

The use of VR technologies in crop production opens up new opportunities for the implementation of environmentally friendly practices. Thanks to modeling and simulations in a virtual environment, farmers can reduce the use of natural

resources, minimize the impact on the ecosystem and implement sustainable farming methods.

Virtual simulations allow for training and testing of agricultural techniques without the use of water, fertilizers and plant protection products. This reduces costs and prevents unnecessary stress on soils and water resources. Instead of real experiments in the field, farmers can optimize their approaches in a VR environment without harming the environment.

VR technologies are actively implemented in crop production, providing innovative solutions for agrotechnical process management, training and modeling. They contribute to increasing efficiency, reducing costs and improving the environmental component of agricultural products.

VR technologies allow modeling the impact of different doses of chemicals on crop development and assessing possible environmental consequences. This allows for optimal strategies to be selected that minimize the use of pesticides and fertilizers, reducing their impact on the ecosystem.

Examples of practical applications of VR in crop production:

- Farmer and student training: Interactive programs with simulation of sowing operations, plant care and analysis of justifications.
- Crop monitoring: Modeling of data on the condition of crops for yield prediction.
- Experimental research: Testing new plant varieties in a virtual environment without real resource consumption.
- Ecological optimization: Analysis of the impact of different management methods on the ecosystem.

Advantages of VR technologies in crop production:

- Reduced resource consumption: the ability to conduct training and experiments without the use of water, fertilizers or pesticides.
- Safe environment: Testing risky agrotechnical solutions without harming real fields and crops.
- Environmental friendliness: Reducing the negative impact on nature through the implementation of precision agriculture.
- Innovation: Increasing the competitiveness of the farm through the integration of new technologies.

VR technologies in crop production are a tool for increasing the efficiency of agriculture, conserving natural resources and ensuring sustainable development. application allows you to adapt to modern challenges, such as climate change, and ensure their stable food security.

Table 1. *The main areas of use of VR in crop production*

Area	**Description**
Personnel training	VR systems do not allow a farmer or student to study the processes of sowing, caring for plants and harvesting in a virtual environment.
Modeling of agricultural processes	Creating simulations to optimize sowing technologies, fertilizer application or pest protection.
Analysis of justifications and crops	Simulating the impact of various conditions (moisture, acidity, structure) on crop productivity.
Study of climatic factors	Modeling of climate change, drought, floods and their impact on yield.
Plant protection	Testing methods for pest or disease control in a safe virtual environment.
Optimization of resource use	Calculation of the required water, fertilizer or pesticides to ensure sustainable crop development.
Increasing yield	Scenario analysis to determine optimal growing conditions and maximum harvest.
Precision farming	Using VR to integrate data from drones, sensors and field maps for precise resource management.

Virtual reality (VR) also opens up new opportunities for optimizing processes in livestock farming, increasing production efficiency, improving animal housing conditions and training personnel. Numerous scientific and technical cooperation projects are being implemented in the EU, the largest of which are Copernicus [6] and FaST [7]. These initiatives provide technical support and contribute to the development of the agricultural sector, helping farmers, state agencies of the Member States that finance these programs, consultants and developers of digital solutions to improve their skills and capabilities in various areas. Copernicus projects, in particular, use satellite data to monitor the state of the environment, predict yields, manage natural resources and prevent emergencies. This allows farmers to receive accurate information to make informed decisions that increase production efficiency and reduce the impact on the ecosystem.

The FaST initiative aims to support innovation and digitalization in agriculture by implementing advanced technologies to automate processes, monitor yields, manage resources, and increase overall productivity. Through these projects, farmers and agribusinesses are provided with access to modern tools and methods that contribute to sustainable development, biodiversity conservation, and climate change mitigation. These initiatives promote the integration of digital solutions into the common practices of agriculture, increasing its resilience and competitiveness at the international level.

Analysis of scientific sources shows that "in the context of globalization of the world economy and the era of information and communication technologies, agricultural producers are forced to introduce network technologies into all areas of activity in order to get closer to consumers and ensure sales and minimize the use of resources and costs. The most promising for agricultural business is the use of network technologies and resources implemented on their basis to solve the tasks of

information search, organization of electronic document flow, project management, optimization of activities and forecasting, marketing and sales, communication with fiscal services, banking, communications, personnel training, and production process management" [8].

***Table 2**. Advantages of using VR in livestock farming*

Direction	**Description**
Education and training of personnel	Creation of interactive simulations for practicing skills in animal care, vaccination or equipment operation.
Monitoring of housing conditions	Simulation of different scenarios to analyze animal housing conditions, their impact on productivity and welfare.
Optimization of feeding programs	Studying the impact of different types of feed on animal health and productivity in a virtual environment.
Improving animal health	VR allows you to simulate the spread of disease and develop strategies to combat them, reducing risks.
Veterinary procedure support	Training veterinarians in simulations of complex procedures, which reduces stress and risk for animals.
Simulation of production processes	Creation of virtual scenarios for herd management, optimization of reproduction or control of milk and meat quality.
Ecology	Changing the impact on the environment through process simulation without real use of resources.

Real-world examples of VR applications:

- Farmer training: Interactive programs to train staff without contact with real animals, avoiding stress for the latter.
- Research: Behavioral training of animal behavioral responses to various factors, such as temperature changes or lighting conditions.
- Livestock monitoring: Analysis of virtual farm models to assess its efficiency and animal comfort.
- Risk reduction: Simulation of emergency situations, such as epidemics, to better train staff.
- VR technologies in livestock farming are a powerful tool to increase production efficiency.

VR systems are becoming an effective tool for teaching ecological approaches in crop and livestock production. Students and farmers can learn methods of organic farming, integrated plant protection and sustainable resource use in a safe virtual environment.

Table 3. *Features of VR systems as an effective tool for teaching ecological approaches in the agricultural sector*

Features of the VR system	**Explanation**
Interactivity	VR allows users to actively interact with the learning environment, simulating a real landscape.
Visualization of complex processes	The ability to display difficult-to-access or invisible processes, such as the development of the root system.
Simulation of real conditions	Creation of virtual fields with external climatic, substantiated and ecological conditions.
Safe experimentation	Training without risk to real crops, justifications or the environment.
Scalability	The ability to adapt training programs to different levels of knowledge and needs of the audience.
Engagement and motivation	The interactive approach interests participants and promotes more effective assimilation of information
Access to updated knowledge	The VR system can be regularly updated with new data on technologies and ecological approaches.
Ability to analyze and evaluate	Integration of tools for tracking learning outcomes and user progress.
Global reach	The use of VR allows you to train people from different regions regardless of their location.

The use of VR reduces the need for frequent field trips for monitoring and training, which contributes to reducing greenhouse gas emissions. This makes the agricultural sector more "green" and environmentally responsible.

Immersive technologies such as virtual reality (VR) and augmented reality (AR) are increasingly integrated into livestock farming, helping to optimize processes, improve animal welfare and increase the efficiency of farm management.

VR simulations allow farm workers and agricultural students to work out animal care techniques, veterinary procedures, and rules for safe handling of animals without the need to interact in a real environment. Reduces risks to people and animals and ensures effective learning of skills.

With the help of AR technologies, farmers can store real-time data on the condition of animals, including body temperature, activity level or changes in behavior. This contributes to early detection of disease and timely measures.

Immersive technologies help to simulate and optimize animal housing conditions, including ventilation, temperature and lighting. For example, VR systems have lost the ability to check how changes in the design of premises affect the comfort and performance of animals.

Table 4. *Advantages of immersive technologies in the agricultural sector*

Benefit	**Description**
Effective learning	Provide hands-on training for students and farmers in a safe virtual environment.
Reduced resource costs	Enable simulations without the use of water, fertilizers, or other materials.
Increased productivity	Optimize processes such as planting, crop monitoring, and harvesting.
Extreme situation modeling	Simulate the impact of climate change, natural disasters, or pests to predict risks.
Environmental friendliness	Reduce chemical use and negative impact on the ecosystem.
Reduced carbon footprint	Accelerate field trips and equipment use, reducing CO_2 emissions.
Access to modern technology	Enables the use of innovative methods for data analysis and decision-making.

The use of VR and AR can help in the analysis of genetic data, modeling of breeding processes and selection of the best individuals to obtain high-quality offspring.

VR allows you to create simulations of different climatic or environmental conditions that interact, how they can affect the quality of animals and how to adapt farm productivity to these changes. VR can be used to create a stimulating environment for animals, especially in confined spaces. This reduces and increases their well-being, which has a positive effect on productivity.

Virtual simulations allow veterinarians to practice complex surgical operations or diagnostic procedures, performing treatment with accuracy and safety.

Table 5. *Examples of the use of immersive technologies in animal husbandry*

Application	**Description**
Virtual employee training	VR simulations for dog training
Animal health monitoring	AR glasses provide temperature information,
Modeling housing conditions	VR systems model optimally
Ration and feeding analysis	AR applications scan feed, analyze its nutritional properties and provide diet recommendations in real time.
Climate change modeling	VR technologies can simulate the impact of climate change, such as drought or temperature increases, on animal performance and develop adaptation strategies.
Creating a stimulating environment	VR technologies create "virtual walks" for animals, reducing their stress levels and improving welfare.
Animal behavior control and adaptation	AR systems analyze animal behavior, identifying stress factors or diseases based on changes in the environment
Large farm management	AR glasses or tablets can view animal health data, maps of their location, and herd performance parameters.

The use of AR applications allows you to analyze animal diets and adapt them to maximize productivity and reduce costs. For example, visualization of the nutrient content of feed in real time allows you to quickly make adjustments.

Advantages of using immersive technologies in animal husbandry:

- Cost reduction: due to accurate forecasting of needs and cost reduction.
- Productivity improvement: optimization of housing, feeding and breeding processes.
- Environmental sustainability: modeling of resource use and reduction of environmental burden.
- Commercial benefit: improving product quality and farm competitiveness.

Implementation challenges:

- High cost of equipment and software.
- The need to train personnel to work with new technologies.
- Dependence on stable Internet connection and infrastructure.

Conclusions

Immersive technologies are becoming an integral part of modern crop production. Their implementation allows farmers to increase production efficiency, reduce costs and increase environmental friendliness. Immersive technologies are also a key tool for modernizing livestock farming, contributing to its development in the face of modern challenges and requirements. Immersive technologies provide the opportunity to make livestock management more precise, efficient, and environmentally sustainable, which contributes to increased productivity and animal welfare. Despite certain challenges, these technologies have the potential to significantly improve the management of agricultural processes, ensuring sustainable development of the industry.

An ecological approach to the use of VR technologies in crop production allows not only to increase production efficiency, but also contributes to the sustainable development of agriculture. These innovations help preserve natural resources, protect ecosystems and ensure food security for future generations.

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AI IN DIGITAL TRANSFORMATION OF HIGHER EDUCATION IN UKRAINE: LITERACY IN FOCUS

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Abstract. The paper is devoted to overcoming undue address of practical use of AI in society and economy. Last 5 years the number of AI related publications has been growing in geometric progression with huge variety of issues raised which brings in the need for proper priority setting by inertial HE system, institutions, professionals and students. Smart development is one of best examples which could popularise the spread of AI wider usage in sectors of economy. There are challenges and promising areas of application of AI in HE identified in the paper. Finally, authors come to conclusion that it is vital to change the situation with AI literacy in global society.

Keywords: AI, higher education, learning process, adaptive learning platforms, integrity, smart development.

Introduction.

The advent of the Fourth Industrial Revolution has ushered in a new era of technological advancement, with Artificial Intelligence (AI) emerging as a transformative force across various sectors. AI, once a realm of science fiction, now stands poised to revolutionize the educational landscape. The integration of AI in higher education aligns with the broader global trend towards smart development, when technology is used to improve the quality of life, economic growth, and social well-being.

Ukraine, a nation striving for digital transformation, as many other countries, is actively exploring the potential of AI to enhance the quality and accessibility of higher education. The educational process has been changing dramatically over the past decade. And a significant impetus for such changes has been, among other things, the rapid spread of the use of AI by scientists, teachers, students, etc. In a broader context, this trend promises both significant benefits and significant problems for society, economy, law and culture.

Results.

Since the early 1970th when number of papers devoted and encompassing AI issues in education started to grow steadily till now the situation has changed dramatically. We have found about 8446 publications in the Scopus database devoted to AI in higher education, ¾ of which have got less than 6 citations. In the last decade the topic has been developing with ever highest rate with 60% of total number of publications becoming available since 2020. However, we must admit

that most cited papers were prepared before 2020 with few exceptions like paper by Cotton D., Cotton P. & Shipway J. (2024) gaining more than 585 citations in few weeks. This made us look at most important topics which have been brought around in last 5 years. So, a semantic map shows high level of interconnectedness of higher education and AI (figure 1.)

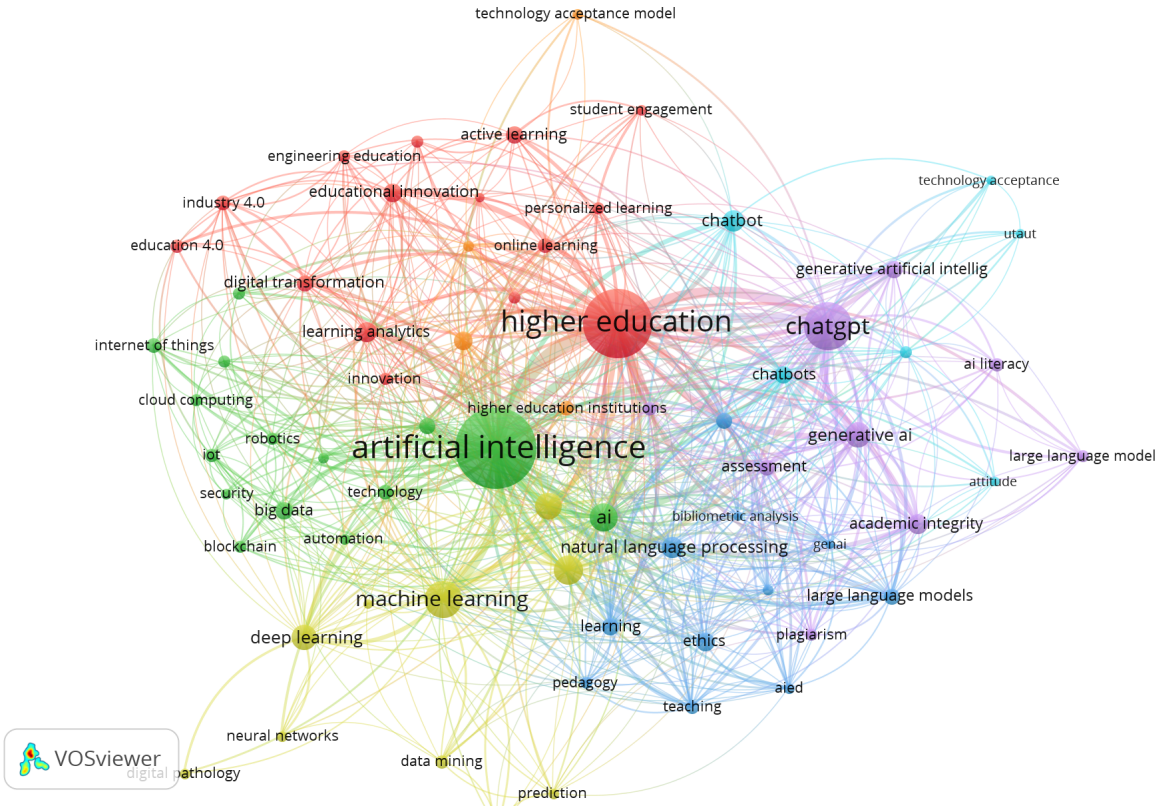

Fig. 1. *Semantic map of higher education and AI since 2019*
Source: authors compilation based on Scopus data and use of VOSviewer

Generative AI has become the main technology trend of 2023. It has not only covered the giants of the industry, but has also begun to play an important role in small companies, even those consisting of one person. In 2024, generative AI is even more actively used to process and integrate different types of data, such as text, images and audio, as well as to create analytics, project management and coding (AI and the global economy (2024)). According to estimates by the international consulting company McKinsey & Company, artificial intelligence programs could bring from USD 2.6 to 4.4 trl to the global economy annually (Chui & Yee (2023)). AI already provides:

- voice bots working in telephone support, capable of understanding the complex intentions of the subscriber (Mastercard (2024)). And thanks to integration with solutions such as ChatGPT, they can conduct increasingly relaxed conversations;

- industry cloud technologies, thanks to which companies exchange data to increase profits by selling information and at the same time benefit from the knowledge of other companies;
- comprehensive business automation in two directions: integrating business with artificial intelligence solutions and consolidating all business processes under one umbrella, which can be, for example, a modern ERP system;
- big data analytics. For example, Netflix uses AI to recommend movies to people based on their viewing history, and Uber to plan price lists and car routes based on demand analysis (Abraham & Edelman (2024));
- supporting business decision-making processes. For example, AI will help analyze market data to predict the potential or suggest a price for a new product; organize chaotic information into clear categories to help make decisions; assess all risk factors in a specific project;
- cybersecurity, which is becoming even more relevant due to new powerful threats associated with the development of AI, such as false information, new types of fraud and deep fakes. Surprisingly, it is AI that becomes the best defence against attacks, because by analyzing millions of fragments of information and detecting violations in them, it is able to detect threats and respond to them faster than a person (Mastercard (2024));
- the development of the Internet of Things. The volume of the IoT market in 2024 is predicted to be 19.2 billion connected devices (Sinha S. (2024));
- the metaworld (virtual space) as a place where high-profile technologies of recent years are used, such as NFT, augmented reality or blockchain. Among the most likely possibilities for its use are the functioning of distributed teams, the sale and exchange of virtual works of art, urban space planning, gamification, etc. (AI and the global economy (2024)).

In the Ukrainian media space, artificial intelligence was mentioned in the context of educational topics almost 10 thousand times in 2023, which is more than IT (8.5 thousand) or content creation (over 7 thousand), although it lags behind war (19 thousand) and the state (12.3 thousand). Despite the relatively small number of mentions, they have a significant potential reach - over 56 million (AI in Ukraine (2024)). The most frequently used words in publications were education, science, national, and language.

Early authors have been too optimistic on the use of AI in education. There many fields for possible automation have been defined as Chen L., Chen P., & Lin Z. (2020) showed, while many more, especially specific ones are to come. Like use of AI to deal with real-time data which would let avoid many future challenges (Gill S. etc. (2025)). Urban development could also benefit from building smarter cities (Yigitcanlar T. etc (2020)), especially those with high concentration of HE institutions. Othengrafen F., Sievers L., & Reinecke E. (2025) have identified at least the following fields where AI could impact smart development - mobility and transport optimisation, energy and infrastructure, public management, public health, and safety, real estate, urban planning, and land use policies. But they can

not effectively develop without proper integration with higher education and becoming learning institutions themselves.

AI can significantly change traditional education, making it more adapted, personalized and accessible to each student. Promising areas of application of AI in the education sector include:

- Formation of adaptive learning platforms that contribute to the individualization of learning, the spread of intelligent tutoring, simplification of foreign language learning, etc. In general, the market for AI assistants is expected to grow to $46 billion in the next four years (Mastercard (2024));
- Automation of routine functions (Shulikin D. (2024)), including assessment and analysis of learning outcomes, administrative processes (e.g., student registration, schedule management, reporting), language translation, etc.;
- Diversification of education by creating virtual learning spaces or simulations where students can study material in an interactive way. This can also be useful for students with disabilities. The augmented and mixed reality technology market is forecast to reach $620.2 billion by 2032 (Mastercard (2024));
- Improving interaction with students: helping to access education in remote or underdeveloped areas; providing access to online courses, interactive materials and video lessons; analyzing the emotional state of students by tracking facial expressions, tone of voice or texts, which will help the teacher better understand the needs of students and, if necessary, provide them with support;
- Improving the content of education by: providing teachers with recommendations on teaching methods; helping to analyze student performance; analyzing feedback from students and improving based on this educational content (automatically improving tests, assignments or even creating personalized textbooks).

Many authors, like Vinothkumar & Karunamurthy (2023) call on responsible AI development to harness its transformative potential while safeguarding ethical considerations. In different sectors of HE the aptitude to AI use differ. In healthcare Sallam (2023) called to adopt code of conduct of AI in order proper use both in academia and practice. But what is even more important is that only those who could raise capital to fund the transformations will be able to get the rent. As Krstić L., Aleksić V. & Krstić M. (2022) said there is a need for a wave of investments.

That is, ideally in our dreams at the moment, thanks to AI, teachers will work easier and more productively, while students will learn more interestingly and, again, the results of such education will grow steadily. However, in today's realities, participants who use AI in the educational process face a wide range of limitations, problems, and risks:

1. Effective use of AI requires highly qualified teachers and high-quality educational materials.

1.1. Teacher training. Teachers may not be sufficiently qualified to effectively use AI in education. Therefore, they need advanced training and support to apply the technology to the maximum effect.

1.2. Adaptation of curricula. The implementation of AI requires updating curricula and methodologies, which is a complex and costly process. In addition, school systems and content must constantly adapt to changing technologies.

2. The dependence of participants in the educational process on technology increases.

2.1. Technical failures. When using AI in education, the negative impact on the educational process of technical failures or infrastructure problems increases, especially in the case of distance learning.

2.2. Technical inequality. Not all students or educational institutions have comprehensive access to the necessary technologies, which can lead to a digital divide. This creates unfair conditions for learning.

3. Ambiguous psychological and social consequences of excessive automation.

3.1. Decreased social skills. Excessive automation can lead to a decrease in live communication between students and teachers, which impairs the development of social skills, emotional intelligence and the ability to cooperate.

3.2. Limited creativity of artificial intelligence. AI is able to effectively help with the reproduction of existing knowledge, but it is ineffective in performing creative or non-standard tasks. The lack of human intuition and creativity can be a limitation for certain educational situations.

3.3. Teacher replacement. While AI can help in personalizing learning, there are concerns about replacing people in the educational process, which could lead to job losses or a reduction in the role of the teacher.

4. Moral and ethical aspects.

4.1. Opacity of algorithms. The algorithms on which AI systems are based are often complex and opaque. This makes it difficult to understand the logic of decision-making (e.g. regarding assessment) and reduces trust in AI.

4.2. Creation of biases. AI can reflect or even reinforce biases in educational materials or assessment algorithms. This will potentially lead to unequal opportunities for students from different social, ethnic or cultural groups.

4.3. Collection and processing of personal data. The use of AI requires the processing of large amounts of data about students, which raises privacy concerns (Shulikin D. (2024)). Data on students' performance, behavior, even emotional state can be vulnerable to leaks or abuse.

5. Potential for abuse and manipulation.

5.1. Impact on academic assessment. AI algorithms can influence assessments and decision-making, facilitating manipulation. For example, automated test scoring systems may bias student work.

5.2. Plagiarism. Using chatbots to assist in learning can facilitate plagiarism or the use of automated decisions, which reduces academic integrity (Rudolph J., Tan S., & Tan S. (2023)).

5.3. Legal plagiarism. AI helps to quickly create texts that look original, but are actually based on existing ideas or phrases. Therefore, students often use AI to write papers without adding their own original ideas or proper citations. In

addition, AI does not have built-in mechanisms to check whether a particular text is original or has already been used by someone else. This puts users in a situation where they may not realize that their text is actually plagiarized because it is very similar to other works.

On the other hand, it is not only automation HE system should think about. There global and basic points of view on this. The global one is about sustainability issues where AI could help both with overcoming global problems and reaching SDGoals. Global society should think in detail how to make best use of AI for this including global neural networks (Greif L. etc (2025)). However, AI competency and literacy is probably more vital topics for the whole suitability of society and there is a need to spread AI literacy on all spheres. Moreover, ss indicated by Ng, D. etc. (2021) the deployment of AI literacy may call the need to change literacy definition which is traditionally used. The AI Competency Framework for Teachers offered recently by UNESCO is one of best practices in this filed which could become basic for higher education (Cukurova, M., & Miao, F. (2024)).

Conclusions. AI has inevitably come into our lives. And it can only be about how to maximize the corresponding benefits while minimizing the real harm and potential risks. So far, the great prospects for the application of AI in education are balanced by significant requirements for additional training of participants in the educational process and significant disadvantages of unqualified or malicious use. The outlined problems require the development of more ethical, transparent and inclusive artificial intelligence systems, as well as proper training and support for teachers and students. In fact every member of global society will face the challenge of proper use of AI.

The successful implementation of AI in higher education requires careful planning, adequate resources, and a strong commitment to ethical principles. As Ukraine aligns its educational strategy with global trends in smart development, it is essential to address the challenges and opportunities associated with AI, such as data privacy, algorithmic bias, job displacement, infrastructure and support systems.

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AN APPROACH TO MODELING EMERGENT COMMUNICATION CONTROLLED BY SPIKING NEURAL NETWORKS

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Introduction

Consider the emergence of self-organization and communication in evolving swarm systems without predefined rules of behaviour.

Chemical signaling is a fundamental mechanism of communication and cooperation in swarm colonies. Social insects such as ants and termites exemplify this, utilizing pheromones to guide collective behavior during foraging. Importantly, coordination within such swarms is decentralized and does not follow a hierarchical structure. Instead, these systems exhibit self-organized behavior, enabling the colony to solve complex problems, such as identifying the shortest path between a food source and the nest, without centralized control.

From a computational perspective, self-organization in swarm systems is typically modeled through interaction rules that govern agent behavior in response to chemical signals and environmental stimuli. These interactions facilitate swarm coordination, allowing agents to collaboratively address tasks such as path optimization. Traditionally, the design of explicit action rules provides a predictable and directed system response, often leading to specific, task-oriented solutions. However, this approach is inherently limited, as it may constrain the system's capacity for adaptive, emergent behaviors.

The challenge lies in identifying the conditions under which self-coordination and emergent communication can arise in swarms without the need for predefined behavioral rules. To address this, it is essential to investigate the spontaneous emergence of coordination within evolving swarms, considering both the physiological attributes of individual agents and the environmental dynamics influencing their interactions.

A promising approach involves leveraging spiking neural networks (SNNs) to model the information processing capabilities of agents. SNNs, which emulate the temporal dynamics of biological neurons, can facilitate decentralized control of agent behavior, enabling real-time adaptation to environmental changes and

interactions with other agents. Furthermore, the evolution of swarm behavior can be driven by the agents' interactions with the environment, leading to the emergence of self-organized communication and coordination mechanisms.

This study aims to explore the emergence of self-organization and communication in evolving swarm systems by:

Modeling agents with biologically inspired neural architectures to simulate their physiological and information-processing capabilities.

Investigating the role of environmental factors in shaping agent interactions and collective behaviors.

Analyzing the conditions under which decentralized coordination emerges without explicitly defined action rules, focusing on the system's capacity for adaptive problem-solving.

The presence of self-organized coordination within such systems is hypothesized to enhance collective problem-solving capabilities, enabling the swarm to dynamically adapt to complex tasks and environmental challenges. This research contributes to a deeper understanding of emergent behaviors in decentralized systems, with potential applications in robotics, distributed computing, and artificial intelligence.

Overview of Existing Research on Swarm Behavior and Control Mechanisms

What is the self-organized foraging in biological and artificial swarms?

The self-organized foraging behavior observed in biological colonies, such as ants and termites, has been extensively studied and replicated in computational models. Vittori et al. and Bandeira de Melo and Araujo developed probabilistic models to simulate the foraging behavior of the Argentine ant Linepithema humile. Their models successfully demonstrated the emergence of shortest path optimization in maze environments through pheromone-based self-organization [2].

Similarly, Hecker and Moses applied ant-inspired swarm algorithms to control both simulated and real robots in dynamic environments with shifting food distributions. By employing a probabilistic model mimicking seed-gathering ants, they optimized collective behavior using a genetic algorithm, illustrating how communication and cooperation strategies evolve over time [2].

Wilensky implemented a rule-based model to simulate self-coordination and cooperation between agents via pheromone trails [2]. While effective, the model relied on predefined rules to guide local decision-making, highlighting a key limitation of traditional approaches in complex, dynamic environments.

lternative approaches have explored the evolution of agent behavior through adaptive strategies. Duan and Sun proposed a framework for soft control agents using an iterative prisoner’s dilemma game. Agents updated their strategies via particle swarm optimization (PSO) mechanisms and shared optimal strategies with peers, allowing for dynamic adjustment of communication frequency and interaction rules [1].

Incorporating SNNs into swarm control offers a biologically inspired solution to the challenges of self-organization. Chevallier et al. introduced the SpikeAnts

model, where each agent was represented by two interconnected spiking neurons. Despite the absence of external stimuli and learning rules, the model exhibited synchronized activity and a distributed learning process, demonstrating the potential of SNNs for decentralized control [1].

Yamazaki et al. emphasized the advantages of SNNs in swarm control, including sparse coding, precise spike synchronization, and biologically inspired local plasticity rules. These features enable efficient information processing, adaptive learning, and real-time responses in dynamic environments [2]. Studies by Nichols et al. and Beyeler et al. further validate the use of SNNs for controlling agents and robots in complex scenarios [1].

Evolutionary algorithms (EAs) for swarm optimization have been extensively used to optimize neural network architectures for swarm control. Christensen and Dorigo evolved swarms of robots capable of hole avoidance and phototaxis, demonstrating the superiority of evolutionary strategies in optimizing collective behavior [1]. Similarly, Trianni and Nolfi applied EAs to design self-organizing behaviors in swarm robotics, with successful real-world implementation on s-bot robots [1].

Waibel et al. investigated the impact of selection pressure and swarm composition on foraging performance. Their experiments, conducted with both homogeneous and heterogeneous swarms, revealed that collective selection pressures enhanced task performance compared to individual selection [3].

Ericksen et al. introduced the Neuroevolution of Extended Topologies (NEAT) algorithm to automate the design of neural network controllers for swarms. Their system, NeatFA (NEAT Foraging Algorithm), outperformed traditional swarm foraging algorithms such as the central place food search algorithm (CPFA) and the distributed deterministic spiral algorithm (DDSA) in large-scale experiments [3].

What are the main challenges and emerging solutions?

Many traditional swarm control methods rely on probabilistic models or predefined rules to guide agent interactions. However, these approaches often require iterative experimentation and rely heavily on the intuition of developers Francesca and Birattari [4]. This design problem by Trianni et al. becomes increasingly complex as the number of agents and task complexity grow, limiting scalability and adaptability.

To address this, recent research has shifted towards connectionist models, where swarm controllers are built using artificial neural networks, including SNNs. These networks offer several advantages:

Sparse Coding: Efficient representation of information, reducing computational requirements.

Local Plasticity Rules: Adaptive learning mechanisms that allow agents to optimize their responses to environmental changes.

Neuromorphic Hardware: Specialized hardware designed to emulate neural architectures, enhancing real-time processing and computational efficiency (Basu et al., Ottati et al., Putra and Shafique.

This shift towards neural-based control systems, particularly SNNs, represents a promising direction for overcoming the limitations of rule-based and probabilistic approaches, enabling swarms to adapt and self-organize in complex, dynamic environments.

Selection of Research Methods and Tools

This study proposes a novel approach where agents within a virtual environment are governed by SNNs rather than predefined behavioral rules. The optimization process is autonomously driven by a fitness function that evaluates task performance, thereby allowing agents to adaptively evolve optimal solutions. Each agent is controlled by an SNN composed of multiple neurons, and the network's synaptic weights and spike time delays are optimized using genetic algorithms (GA).

Scheme of the optimization process is shown on the Fig. 1.

The agents are tasked with navigating a virtual environment for the dual objectives of «searching for food» and «returning home». Initially, the SNN lacks a predefined mechanism for communication or coordination, with no explicit mapping between sensory inputs and motor outputs. The virtual environment is modeled after the ant colony simulation developed by Wilensky, where agents interact and self-organize through environmental feedback.

To optimize SNN parameters, we integrate the Learning to Learn (L2L) framework by Yegenoglu et al. [3], the NetLogo multi-agent simulator by Tisue and Wilensky [4], and the NEST SNN simulator by Gewaltig and Diesmann [5].

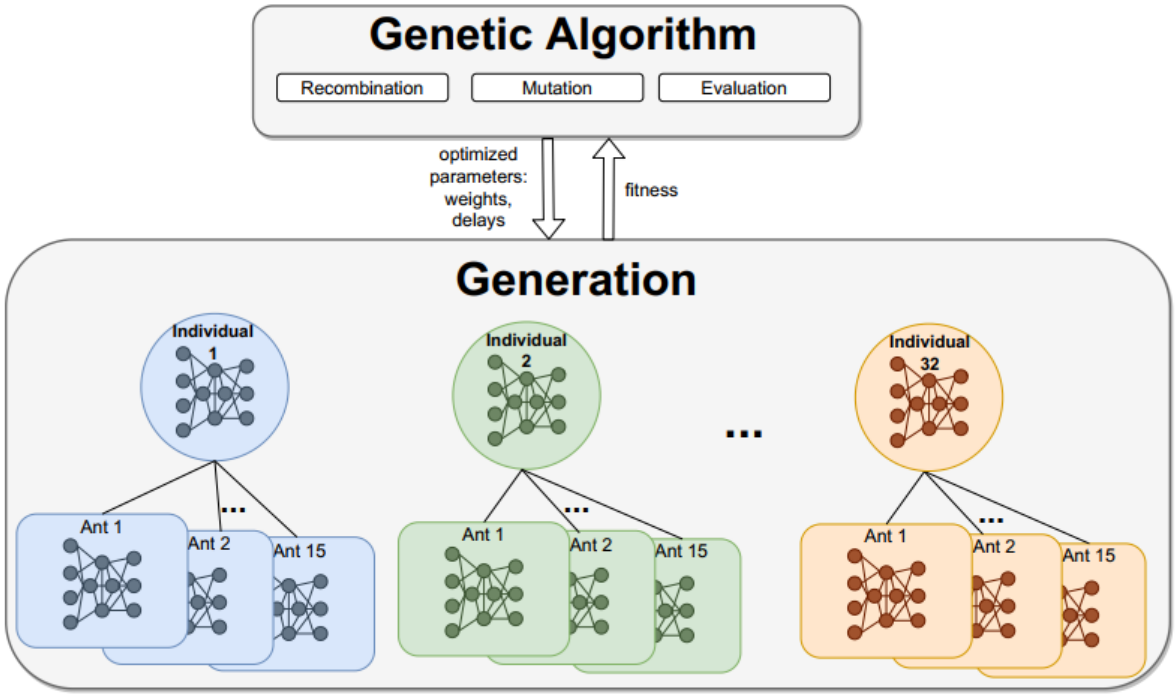

Fig. 1. *Optimization scheme*

The optimization workflow, as depicted in Fig. 1, involves the following steps:

Population Initialization: Each generation comprises 32 individuals, where each individual represents a unique SNN instance. Importantly, an individual refers to the SNN itself, not to a single agent.

Colony Simulation: Each simulation consists of 15 agents referred to as «conditional ants», all controlled by identical copies of the SNN instance. This setup results in 32 parallel simulations, with a total of 480 SNNs per generation.

Task Execution: Each colony operates in a 2D virtual environment, performing the task of locating and retrieving food. The simulation concludes with the evaluation of each colony's performance based on a predefined fitness function.

Genetic Algorithm Optimization: The genetic algorithm adjusts the synaptic weights and spike time delays associated with each connection in the SNN. These parameters constitute the genome of each individual in the population. Over successive generations, selective pressure drives the evolution of these parameters, leading to an optimized configuration that maximizes task performance.

The proposed methodology leverages three interconnected components:

Learning to Learn (L2L) Framework: L2L 1.0.0-beta serves as the workflow coordinator, managing both the optimization algorithm and the simulation parameters.

The framework operates in two nested loops:

The inner loop defines the optimization object (SNN) and evaluates its performance on specific tasks. In this study, the SNN's performance on the «food search» task is assessed rather than directly trained.

The outer loop optimizes the parameters of the SNN using a genetic algorithm. The goal is to achieve generalized performance and rapid adaptability to new, unseen tasks.

NetLogo 6.2.0 Multi-Agent Simulator: NetLogo is employed to simulate the interactions between agents and their environment.

Each agent («conditional ant») is governed by a common SNN instance.

Pheromone patches are used to model the communication signals exchanged between agents.

Agents can perceive pheromone concentrations and modify their behavior accordingly, simulating biological pheromone-based communication.

NEST 3.0 Neural Network Simulator: NEST 3.0 provides a scalable platform for modeling large-scale SNNs with biologically realistic connectivity.

The simulator supports multi-threaded and parallel execution, enabling efficient simulation on various hardware configurations, from local machines to high-performance computing systems.

The NEST simulator facilitates the modeling of neuron dynamics, spike propagation, and synaptic plasticity, which are critical for emulating adaptive agent behaviors.

Genetic Algorithm for Neural Network Optimization

The genetic algorithm operates in the parameter space of synaptic connections, focusing on two key variables:

Synaptic Weights: Governs the strength of the connection between neurons, directly influencing spike propagation and signal integration.

Spike Time Delays: Represents the temporal delay in signal transmission between neurons, affecting the timing of neural interactions and overall network dynamics.

The genetic algorithm iteratively adjusts these parameters, selecting individuals with higher fitness scores for reproduction. Over successive generations, the population converges towards an optimal set of parameters that enhances the collective performance of the agent swarm in the simulated environment.

Thus, the proposed approach integrates state-of-the-art tools and techniques for evolving self-organized swarm behavior through spiking neural networks. By leveraging GAs, multi-agent simulation, and neural network modeling, this framework aims to advance the understanding of adaptive coordination and communication in decentralized agent systems. The combined use of the L2L framework, NetLogo simulator, and NEST neural network simulator provides a robust platform for exploring complex, dynamic swarm behaviors in a biologically inspired context.

Conclusions

This study presents a framework for implementing a virtual environment in which the behavior of agent populations, governed by SNNs, can be optimized using GA. The integration of the L2L metasystem, the NetLogo multi-agent simulator, and the NEST SNN simulator is validated as a cohesive toolchain for facilitating the autonomous evolution of agent behavior.

The proposed SNN architecture demonstrates the capability to encode sensory input from the environment and regulate agent actions in the execution of complex tasks. Through iterative optimization based on a fitness function that quantifies task performance, the GA effectively adjusts the synaptic weights and spike transmission delays of the SNN, enabling agents to improve their efficiency over successive generations.

This framework holds potential for broader applications in the fields of neurorobotics and collaborative cobotics, where it can be extended to investigate emergent coordination and communication strategies among decentralized autonomous agents operating in dynamic environments.

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DECARBONIZATION WITH THE HELP OF ARTIFICIAL INTELLIGENCE - ONE OF THE PRIORITIES OF INTERNATIONAL CIVIL AVIATION

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Abstract. The article is devoted to the analysis of the role of the International Civil Aviation Organization in solving the problem of global warming, one of the main causes of which is considered to be the increase in greenhouse gas emissions into the atmosphere, highlights directions for achieving the goal of decarbonization of civil aviation by 2050. An analysis of aviation experts' proposals for reducing CO_2 emissions through AI was conducted, which can help reduce the environmental impact of aviation, improve aircraft and engine technologies, use sustainable aviation fuel (SAF), implement economic measures, and improve air traffic management and aircraft operations. Harnessing the power of AI to develop more efficient aircraft and engines will help bring zero-emission aircraft to market by 2035. An important area of carbon reduction is the ability of airports to provide clean airspace. Airports Council International has set high standards for reducing absolute carbon emissions. ACI and its member airports have already committed globally to achieving net zero carbon emissions by 2050, with the support of governments. Ukraine has undertaken international legal obligations to implement a program to reduce greenhouse gas emissions into the atmosphere, which are mandatory for implementation after the restoration of airport infrastructure destroyed as a result of the Russian invasion, in particular, obtaining Airport Carbon Accreditation. It is argued that research into AI capabilities, technological advancements, infrastructure development and operational improvements, and collaboration between governments and industry stakeholders are crucial to creating the necessary foundation to achieve decarbonization goals.

Keywords: Reducing CO_2 Emissions, Decarbonization, Artificial Intelligence, Ecological Aviation Fuel, Aviation Technologies.

Introduction

The aviation sector is under intense scrutiny due to its significant environmental impact. Aviation accounts for approximately 2% of global energy-related carbon dioxide (CO2) emissions, but international civil aviation organizations (ICAO, Eurocontrol, and others) have set ambitious targets for net zero emissions by 2050.

AI has a unique opportunity to accelerate the search for optimal directions for sustainable development of civil aviation, as it has the ability to help solve complex problems unique to the aviation industry.

Artificial intelligence innovations have the impact of increasing fuel efficiency and reducing the environmental footprint of the aviation industry, contributing to a greener and more sustainable future of air transport.

The efforts of international and European organizations are an example of the international desire to work together to develop further AI innovations.

The increase in the volume of air transportation in the world is accompanied by an increase in indicators of the negative effects of the activities of aviation enterprises and airports on the environment. Responding to the climate emergency will require an unprecedented level of global cooperation and commitment. The Paris climate agreement, adopted at the climate conference in Paris (2015), is an international initiative to combat global warming, one of the main causes of which is considered to be the increase in greenhouse gas emissions into the atmosphere. The Paris Agreement sets the goal of keeping the global temperature on Earth within 2°C by 2100 [1]. 196 countries, including Ukraine, joined this agreement. The Paris Agreement requires each country to submit an updated national climate change action plan, known as a Nationally Determined Contribution (NDC), every five years. In their national reports, countries report on the actions they are taking to reduce greenhouse gas emissions. Countries also report on the actions they plan to take in the future to increase resilience to the effects of rising temperatures.

The aviation industry plays an important role in the global development of social relations through advances in technology and infrastructure development. For the purpose of creating a better aviation space for future generations, reducing the global impact on the climate, the International Civil Aviation Organization (ICAO) is actively involved in the implementation of the provisions of the Paris Climate Agreement, as well as the document United Nations «Sustainable development goals for the period up to 2030» [2], developing standards and recommendations. Among the 17 Sustainable Development Goals, ICAO pays special attention to such civil aviation priorities as safety, air navigation capacity and efficiency, security and simplification, economic development of air transport and environmental protection [3]. Through the development of international standards and recommended practices, ICAO contributes to the safe and orderly development of international civil aviation throughout the world. The 1944 Convention on International Civil Aviation declares that the efforts of ICAO are aimed at ensuring that civil aviation can develop in a safe and orderly manner, so that international air services can be established on a basis of equality by air and be carried out rationally and economically [4].

At the 41st ICAO Assembly (2022), States emphasized the importance of effective financing and investment support to achieve the CO_2 reduction target and fully supported the ICAO Aviation Fuels Assistance, Capacity Building and Training (ACT-SAF) program aimed at disseminating and the use of SAF, offering to continue discussions on alternative fuels as well [5]. A key element is the goal of reducing CO_2 emissions from international aviation by 5 percent by 2030 through the use of SAF and low-carbon aviation fuel (LCAF). Participating states support the safety of air transport, including a key global agreement to achieve its full

decarbonization by 2050, promote cooperation between states by providing recommendations on economic policy, implementing relevant measures, creating the necessary regulatory and legal acts [6].

The use of sustainable aviation fuel (SAF) is critical for airlines. A flight that consists of 100 percent SAF can effectively use the full emission reduction potential of this environmentally friendly fuel, reaching up to 80 percent compared to traditional jet fuel over the entire life cycle. As the expected increase in supply will reduce the cost of purchasing SAF in the coming years, this decision becomes economically feasible, allowing for significant emission reductions for the business aviation sector [7].

The international community has the opportunity to communicate not only with airports, airlines, aircraft designers, but also with fuel producers, investors, banks, associations, international organizations and other interested parties. In the future, AI can help in the development and implementation of environmentally friendly aviation fuels by analyzing data on biofuel production, performance and environmental impact, accelerating the transition to cleaner fuels.

Developed countries should be involved in providing financial assistance to countries that are less well-off and more vulnerable, encouraging voluntary contributions from other parties. Climate finance is needed for mitigation because significant emissions reductions require large investments.

Research Methodology

The methodological basis of the study is a system of general and special means of scientific knowledge of the features of such an important issue of international civil aviation as reducing carbon emissions, which is of practical importance for ICAO member states, including Ukraine. The substantiation of the priority areas of decarbonization research for the period up to 2050 is being carried out. The study uses a global reporting format analysis method to investigate ICAO's recommendations for the use of aviation fuel (SAF), low-carbon aviation fuel (LCAF) and other clean energy sources, which would provide more than half of the required emission reductions. Document analysis was used to collect data. Relevant information was obtained from trainings, webinars and documents on the ICAO website, which are constantly updated by international aviation organizations. This allows us to analyze the current state of legal regulation of the implementation of the relevant regulatory framework, the potential evolution of the strategies of international and European civil aviation organizations in the coming decades, and its impact on the environment.

Addressing the challenge of decarbonization requires creating a universal system to orchestrate a safe future for international flights, implementing innovation and expanding partnerships between the UN and stakeholders, leveraging advances in artificial intelligence to deliver a strategic global vision and effective, sustainable solutions.The CORSIA Agreement (Carbon Offsetting and Reduction Scheme for International Aviation) provides guidance for ICAO and its member states to cooperate with the aviation industry. A number of states require targeted assistance to prepare for the implementation of the CORSIA monitoring, reporting and

verification (MRV) system Technical experts work together with States' CORSIA Focal Points to provide on-the-ground training and closely monitor the preparation and implementation of Member States' CORSIA framework [8]. The systematic method of research allows to justify several directions for achieving the goal of decarbonization of civil aviation by 2050, for example, improvement of aviation technologies; modernization of energy infrastructure; improvement (discovery of new) methods of operation of existing aircraft. The prognostic method makes it possible to determine ways of improving air transport to zero net international aviation, which requires the financial support of state policy. Compliance with the requirements of standards and recommended practices regarding the decarbonization of international civil aviation, clarification of the requirements of acts of international and European civil aviation organizations requires attention, which determines the relevance of the chosen topic.

Research results.

Aviation professionals are constantly searching for innovative solutions to improve efficiency, safety and passenger service. Artificial intelligence has the ability to process huge amounts of data and identify complex situations. AI applications are revolutionizing various aspects of aviation, including flight optimization and predictive maintenance, and improving air traffic management.

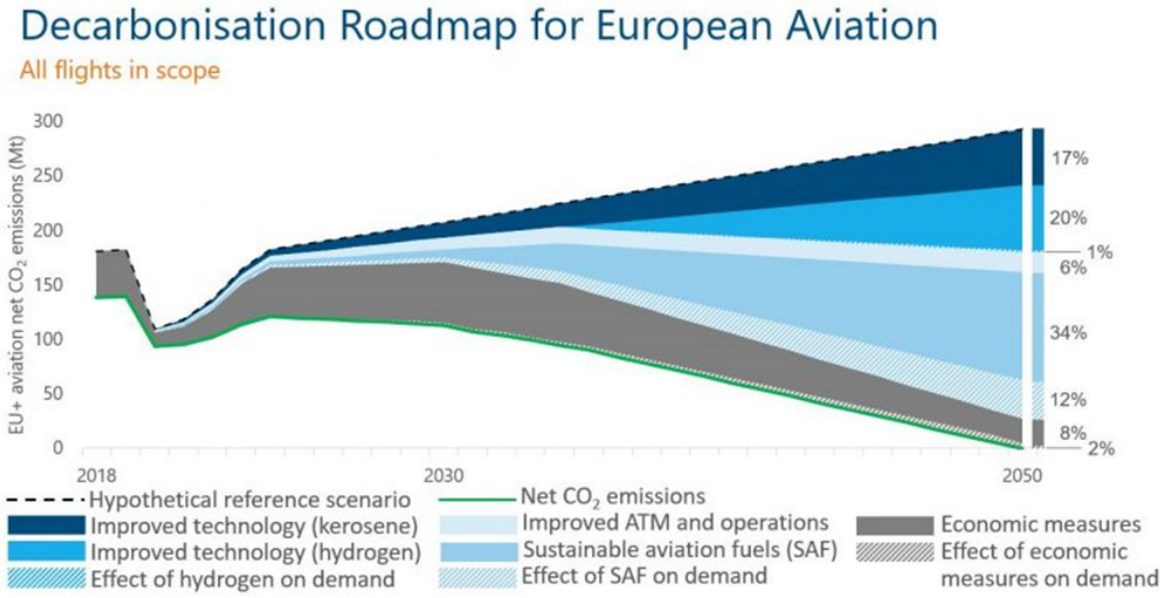
Environmental protection is a priority task for international and European civil aviation organizations. With the growth of air traffic, airports must provide environmentally clean airspace. Scientists draw attention to the fact that modern airports have a rapidly developing infrastructure. As a result, objects of non-aviation activity are appearing, the number of which is increasing. All this leads to an increase in the demand for electrical and thermal energy [9].

The program of voluntary accreditation of European airports regarding the implementation of limiting the impact of aviation on the environment began to operate in June 2009. ICAO provides States with practical information on airport planning and design and presents specific options that they can use. For example, the goal of the Eco-Airport Toolkit electronic collection is to provide practical and ready-to-use information to support the development of airport infrastructure projects. The recommendations take into account the urgent operational needs of the states. Each recommendation addresses a specific aspect of environmental planning at airports. "Eco-Airport Toolkit" is a new document for states to make informed decisions when financing a new airport infrastructure project or environmental management improvement programs [10], for example, sustainable Considerations for Airport Surface Access; Air Quality Management at Airports; GHG Management and Mitigation at Airports; The Eco Design of Airport Buildings; A Focus on the production of renewable energy at the Airport site; Waste Management at Airports.

Global greenhouse gas emissions have increased significantly over the last century, mainly due to industrial activities, the burning of fossil fuels and deforestation. This rise in CO_2 levels is a major driver of climate change, leading to a warming atmosphere, rising sea levels and more frequent extreme weather events.

Efforts to mitigate these emissions are critical to slowing the rate of global warming and reducing its impact on ecosystems and human societies.

The European Union will win a decisive role in achieving global net zero carbon goals adopted by ICAO. The European Commission funded seven SAF feasibility studies in Africa and the Caribbean proposed by ICAO. By 2026, more than 20 such SAF studies are planned, of which 10 will be conducted in Africa and India, funded by the European Commission [11]. The European aviation sector has unveiled its flagship sustainability initiative, Destination 2050 – the path to net-zero European aviation [12]. This document envisages that by 2050 all flights within the EU will have zero CO_2 emissions. A comparative overview of aviation transition paths to zero CO_2 emissions shows that there are several paths to achieving the goal of decarbonizing aviation by 2050. The largest decarbonization in 2050 will occur through SAF. It is sustainable aviation fuel (SAF) that will contribute the largest CO_2 reduction by 2050, with the role of SAF ranging from 24% to 70%. Financial support from government policy is needed to increase SAF production. To calculate the reduction of CO_2 emissions, experts of international civil aviation organizations offer several directions**:** improvement of aviation technologies; modernization of energy infrastructure; improvement (discovery of new) methods of operation of existing aircraft [13]. For example, improvements in aviation technology involve the development of more efficient aircraft and engines. Of particular importance are the steps required to ensure aircraft can operate 100% on SAF fuel, hydrogen or batteries. All development steps depend on investment programs. New engines, aerodynamics, aircraft designs and flight systems are also important. The IATA Net Zero Roadmaps are the first detailed assessment of the key steps needed to accelerate the transition to net zero by 2050. Road maps oriented on airlines, as well as on governments, suppliers and financiers. Collaboration between governments and industry stakeholders is critical to achieving decarbonization goals.



Source: [12]

The table shows that improving aircraft and engine technology through artificial intelligence can achieve a 37% reduction in emissions; the use of sustainable aviation fuel (SAF) can achieve a 34% reduction in emissions; the implementation of economic measures can achieve an 8% reduction in emissions; and improving air traffic management (ATM) and aircraft operations can achieve a 6% reduction in emissions.

Let's analyze several examples of improvement of aviation technologies. According to Airbus, it is developing a new aircraft that will run on hydrogen stored at a temperature of -253°C, and is also developing new cryogenic hydrogen storage tanks for future liquid hydrogen aircraft, which are at the heart of the new hydrogen aircraft ZEROe. Hydrogen is key to the mission to bring zero-emission aircraft to market, but it must be stored at an extremely low temperature of -253°C. Airbus explains that there are two main technologies that allow the aircraft to fly directly on hydrogen: powering the engine that burns hydrogen through modified gas turbine engines or using hydrogen fuel cells to generate electricity. Another option is a hybrid approach that uses a combination of both technologies [14]. This project brings environmental sustainability to the forefront of the industry. The use of innovative technologies will help bring zero-emission aircraft to the market by 2035.

The European Union Aviation Safety Agency (EASA) is setting safety standards for AI in aviation. The EASA AI Roadmap outlines a strategy for integrating AI technologies while maintaining human control and accountability. EASA fosters innovation in the aviation sector, ensures the safe deployment of AI, and supports the evolution of the industry.

Company SE Aeronautics has unveiled a new giant jet concept that takes an unusual approach to all aspects of wide-body aircraft design and performance, including the rarely seen three pairs of wings, dual tail stabilizer and twin rear engines. The new prototype, named the SE200, can carry 264 passengers and consumes 70% less fuel than other aircraft of a similar size [15].

The aviation industry is exploring new approaches to bringing hybrid and electric aircraft to market, improving environmentally friendly aviation fuels and battery technologies. The Eather One aircraft will use air friction to generate energy. Eather One will generate renewable energy by harnessing the strong friction that occurs between the aircraft and the air as it flies at high speeds. As a result, the jet would not need fuel tanks or batteries, as it would generate energy from the surrounding air. This energy will be used to power the engine and electric motors, as well as to charge the batteries [16].

The new JetZero Blended Wing aircraft will significantly improve aerodynamic efficiency. JetZero has announced that its blended wing demonstrator has received FAA approval to begin test flights. A blended wing aircraft is where the fuselage and wings blend together to form a smooth shape that is a cross between a conventional airliner and a flying wing. JetZero claims its blended wing will use 50% less fuel than a standard jet [17].

Aerospace startup AMSL Aero (AMSL) has begun development of a hydrogen-electric vertical take-off and landing eVTOL aircraft that could revolutionize regional air transport. Designed as a low-noise and high-speed zero-emission eVTOL, Vertiia

will be able to carry up to five passengers over a distance of 1,000 km. Such an aircraft is important for use in medical aviation, emergency services, as well as for passenger and cargo transportation. Its unique configuration offers emergency services new ways to deal with special situations, such as fighting forest fires. In addition to increasing the flight range, switching to hydrogen as a fuel will allow the Vertiia to refuel much faster, making it more practical and economical [18].

The analyzed examples illustrate the enormous potential that AI offers for reducing CO2 emissions. AI conducts computational fluid dynamics modeling, modeling airflow over aircraft surfaces, which leads to optimization of wing shapes and other important components, which reduces CO2 emissions. The future of flying is becoming safer, more efficient, and increasingly dependent on the information that AI can provide. AI is having a significant impact in predictive maintenance. By analyzing data from aircraft sensors, AI can predict potential failures before they occur. This approach helps reduce maintenance costs and increase aircraft availability. Efficiency is improved through AI algorithms that optimize fuel consumption. AI analyzes flight data to suggest optimal speeds and routes, contributing to decarbonization.

Backtracks, the thin white lines that follow airplanes, have a big impact on the climate. The clouds created by contrails are responsible for an estimated 35% of aviation's global warming impact, accounting for more than half of the global impact of jet fuel. Unlike typical greenhouse gas emissions, contrail formation depends on specific atmospheric conditions, such as humidity and temperature. Weather forecasts are designed to work at low altitudes and do not work well at flight altitudes, and humidity measurements are lacking.

It is AI that can synthesize signals from multiple data sources. By combining weather, satellite, and flight data, AI can predict when and where contrails are likely to form, which can then be used to adjust flight altitudes.

AI has a unique ability to accelerate contrail avoidance, which could reduce aviation's climate impact by 35%.

The international drive to work together to develop AI capabilities is accelerating aviation's transition to sustainability, the industry's move toward net zero.

So, the aviation industry plays an important role in the global development of social relations thanks to the progress in technology and the development of infrastructure. Improvements in aircraft and engine technology can change the situation. The activities of the aviation technological complex show that by 2035, planes with highly efficient power plants and 30% less fuel consumption may appear. The development of more fuel-efficient aircraft, engines and optimized range and capacity of hybrid-electric rotorcraft and regional aircraft will reduce CO_2 emissions per flight by 50%. Hydrogen-powered aircraft and hybrid-electric helicopters and regional aircraft require special technological readiness by 2027-2030 at both the aircraft and power plant levels [19]. Once ready, the new technologies should be rapidly incorporated into all commercial fixed-wing and rotary-wing products. This will require new and effective certification procedures for

revolutionary technologies. Therefore, aircraft and engine upgrades will continue to reduce CO_2 emissions and achieve the goal of decarbonizing civil aviation.

In the future, AI has the potential to help design more fuel-efficient aircraft by analyzing massive data sets and running simulations to optimize aerodynamics, materials, and engine performance.

Discussion

By integrating AI systems, airlines and airports can improve decision-making processes and ensure aviation safety. AI quickly analyzes huge amounts of data, helps predict and prevent potential hazards. Intelligent systems can monitor performance in real time, detect potential anomalies, and recommend corrective actions. Implementing AI not only simplifies operations, but also significantly reduces the risks associated with human error.

A growing number of ICAO member states are voluntarily participating in the International Aviation Carbon Offsetting and Reduction Program, which will help meet global fuel efficiency goals. Airlines and airports around the world recognize the importance of reducing, reusing and recycling waste. Concerned about environmental protection, ICAO develops recommendations for environmentally friendly airports, analyzes policies for recycling aircraft at the end of their service life. ICAO conducts research on the economic, environmental and social impact of civil aviation and shares experience with other international organizations. Airport carbon accreditation enhances the ability to promote and drive the ambitions of the airport industry to achieve net zero CO_2 emissions. An important area of reducing carbon emissions is the ability of airports to provide environmentally clean airspace. The Airports Council International has developed the Level 5 Airport Carbon Accreditation Program - this is the highest level of the global standard of carbon management and reduction for airports, its implementation is another step in the management of carbon emissions in airports, the certification of airports to achieve and maintain a net zero carbon balance for emissions, which they control, and extending mapping, impact and reporting requirements to all other emissions [20]. Airports that achieve this level are fully compliant with the Paris Agreement target for emissions under their control, while advocating for the transition to zero balance among their business partners, including airlines, ground handling companies, retailers, tenants.

Among the priorities for the implementation of aerodrome certification are the aerodrome's physical environment, visual aids and other infrastructure, its operational procedures and safety management system, relevant documentation, as well as the aerodrome's compliance with regulatory requirements for issuing a certificate [21].

Level 5 is the highest level in the airport's Carbon Accreditation program, setting high standards for airports to significantly reduce absolute carbon emissions. Airports at this level must work with their entire ecosystem, including employees, suppliers, business partners, airlines and third parties operating on the airport premises, to reduce CO_2 emissions in line with the sector's wider Net Zero

commitments. Regular monitoring and evaluation are essential to measure progress and ensure transparency.

The new level of accreditation demonstrates that the airport maintains a net zero carbon balance. To achieve Level 5 accreditation, an airport must develop a Carbon Management Plan (CMP) that describes the steps to achieve emission targets, encourage third parties at the airport to self-deliver CO_2 reductions through milestones in line with net zero commitments. Airports Council International's Airport Carbon Accreditation program assesses and recognizes airports' efforts to manage and reduce carbon emissions through its certification levels: «Mapping», «Reduction», «Optimisation», «Neutrality», «Transformation», «Transition» and «Level 5» [20].

In May 2024, the Airports Council International (ACI) reported that Finnish airports had achieved a net zero CO_2 balance under their control. The four regional airports managed by Finavia - Ivalo, Kittila, Kuusamo and Rovaniemi - meet all the strict requirements of level 5 carbon airport accreditation [22].

In 2023, Finavia switched to using renewable motor fuel in heavy airport equipment, such as fire engines, at Ivalo, Kittila, Kuusamo and Rovaniemi airports. The airport operator has also switched to renewable energy sources for terminal heating, such as biofuel-based district heating. In addition, ground handling is carried out with the help of electric vehicles or only with the use of renewable energy sources. In this way, Finavia was able to minimize carbon dioxide emissions from its operations and achieve the goal of zero emissions at four airports in Northern Finland. By switching exclusively to renewable energy sources, Finnish airports have reduced their carbon emissions by 98% over the past ten years. The airport operator has also switched to renewable energy for terminal heating, such as biofuel-based district heating. In addition, ground handling is carried out with the help of electric vehicles or only with the use of renewable energy sources.

As of June 2024, 14 international airports have met the stringent Tier 5 requirements, including reducing emissions by 90% by removing the remainder from the atmosphere with new technologies and committing to be net zero in Area 3 by 2050 or earlier: Amsterdam Airport Schiphol Airport Eindhoven, Rotterdam The Hague Airport, Beja Airport, Madeira Airport, Ponta Delgada Airport, Christchurch Airport, Gothenburg Landvetter Airport, Malmö Airport, Toulon-Hyères Airport and the Lapland Airport Group: Ivalo, Kittila, Kuusamo and Rovaniemi [23].

The researchers recommend that airport operating companies take the first step by establishing local "decarbonization" councils that bring together all relevant airport-specific stakeholders. Thus, airports can take an active role in promoting sustainable development. But more importantly, the councils they bring together can coordinate comprehensive actions that really effectively reduce CO2 emissions [24].

Although airports only account for a small proportion of industrial emissions, they should prioritize decarbonisation. Airports Council International and its members are committed to implementing clean technologies, reducing carbon and greenhouse gas emissions, and exploring new market opportunities. More than 130 ACI member

airports plan to reach the goal by 2030 or even earlier. Some plan to be net zero by 2040, while others will need additional support to develop and implement their decarbonisation roadmaps. ACI works with governments and other sectors to support all its members in achieving these ambitious but achievable goals [25].

With levels of certification, Airport Carbon Accreditation confirms that airports are at different stages of their journey towards integrated carbon management. It is a program for airports of all sizes, beyond hub and regional airports with regular passenger traffic, including general aviation airports and cargo airports.

The integration of artificial intelligence into aviation is driven by the need to solve existing problems, while setting ambitious goals for the future. With the help of innovative AI solutions, the aviation industry seeks to improve safety, reduce CO2 emissions, and contribute to climate improvement. AI can optimize flight routes, significantly saving fuel and reducing emissions. AI can suggest the most efficient flight routes by analyzing weather conditions and air traffic.

The application of AI in aviation allows for the optimization of flight trajectories. Using machine learning algorithms, airlines can analyze huge amounts of data related to weather conditions and air traffic. This allows them to determine the most efficient routes, reducing fuel consumption and minimizing carbon emissions.

The integration of artificial intelligence into aviation can fundamentally change the industry. The expected transformations lead to a safer, more efficient, and more environmentally sustainable aviation ecosystem.

The analyzed ways of decarbonization of the air space can ensure the achievement of a high level by 2050. However, their effective implementation requires significant funding, assistance from international civil aviation organizations, specialized software, and qualified professionals. ICAO standards and recommendations make it possible to achieve the set goal.

Ukraine has undertaken international legal obligations regarding the implementation of sustainable low-carbon development in all sectors of the economy; creation of an effective legal mechanism that would reliably guarantee the priority of environmental safety; implementation of precautionary measures for environmental protection; safe implementation of the latest technologies, etc. [26]. Global experience and the results of implementing investment projects to improve the energy efficiency of individual cities of the country (Kyiv, Dnipro, Lviv, Uzhhorod, etc.) can be used to spread the low-carbon policy at the non-aviation facilities of Ukraine's international airports [9].

In September 2022, the Parliament of Ukraine ratified the agreement on Ukraine's participation in the EU LIFE program for climate and environment [27]. By joining the LIFE program, Ukraine will be able to receive funding for recovery of its environment after the destruction caused by the Russian invasion, in particular, recovery airport infrastructure, obtaining the Airport Carbon Accreditation of the International Council of Airports.

Conclusions.

Thus, reduction of CO_2 emissions can be achieved through improvements in aircraft and engine technologies, use of sustainable aviation fuel (SAF),

implementation of cost-effective measures, improvements in air traffic management (ATM) and aircraft operations. Airspace modernization or the use of more economical aircraft reduce carbon emissions, contribute to the achievement of the desired Net Zero goal of international civil aviation. Technological progress, infrastructure development and operational improvements, collaboration between governments and industry stakeholders are critical to creating the necessary framework to achieve decarbonisation goals. The adoption by the ICAO Assembly of the Long-Term Global Preferred Target (LTAG) for international aviation for net zero carbon emission by 2050, the adoption of the ICAO Global Plan for Sustainable Aviation Fuels (SAF), Low Carbon Aviation Fuel (LCAF) and other clean energy forms contributes progress in the implementation of these important issues.

Artificial intelligence plays a crucial role in improving air traffic management, increasing efficiency and safety, and enabling decision-making to address the issue of reducing CO2 emissions. The integration of AI into air traffic management has a direct impact on aviation safety.

AI has revolutionary potential in the aviation industry, offering significant safety benefits. While challenges and risks exist, the continued development and responsible implementation of AI will shape the future of air travel, creating the necessary foundation to achieve decarbonization goals.

The use of AI accelerates the development of clean aviation fuels, helps reduce the aviation industry's carbon footprint, and demonstrates that AI can revolutionize the development of sustainable aviation fuels by making SAF more accessible.

AI can optimize flight routes to reduce fuel consumption and emissions, contributing to a greener future. Harnessing AI advances will help further improve energy management practices in airports and aircraft, aligning the industry with global sustainable development goals.

By harnessing the power of artificial intelligence, the aviation industry is discovering new ways to improve efficiency, safety, and sustainability. With artificial intelligence, operational efficiency and environmental responsibility will be seamlessly integrated.

Success requires the coordinated efforts of the entire industry (airlines, airports, air navigation service providers, manufacturers) and significant government support. Member States of international and European civil aviation organizations should continue to develop national legislation to reduce CO_2 emissions in civil aviation. Airspace modernization or the use of more economical aircraft reduce carbon emissions, contribute to the achievement of the desired Net Zero goal of international civil aviation. Technological progress, infrastructure development and operational improvements, collaboration between governments and industry stakeholders are critical to creating the necessary framework to achieve decarbonisation goals. Civil aviation is one of the most important branches of the national economy, its effective functioning is a necessary condition for stabilization, development of international activity, meeting the needs of the population in air transportation, ensuring the protection of the national interests of states, in particular, Ukraine, with the aim of creating a better aviation space for future

generations, reducing the global impact on the climate, as well as to achieve zero net carbon emissions by 2050.

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MODERN MATHEMATICAL APPROACHES TO ASSESSING THE RELIABILITY OF INFORMATION FROM DIGITAL SOURCES IN SCIENTIFIC RESEARCH

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Abstract: The article presents a mathematical methodology for evaluating Internet sources, based on the analysis of three key criteria: source authority, peer review and relevance of information. The proposed methodology provides an objective assessment of the reliability of sources through a numerical scale, which simplifies the choice of resources for scientific activities. areas of research that cause irrational expenditure of financial, time and intellectual resources.

The study is extremely relevant in modern conditions, when the so-called "economic order of fakes" dominates, where the spread of false information can destabilize both academic and practical activities. The use of a reliable mathematical model allows you to reduce the risks of making erroneous decisions caused by unreliable data, as well as to support the efficiency of research processes.

The practical significance of the methodology is demonstrated through the evaluation of popular sources in the fields of business, cybersecurity and technical sciences. The article emphasizes the need to give preference to highly reliable sources and carefully work with those with an average level of reliability. The proposed approach will help minimize the negative consequences of the use of false information, conserving resources and promoting the development of scientific research based on verified data.

Keywords: Mathematical Methodology, Reliability Assessment, Internet Sources, Scientific Activity, Authority, Peer Review, Relevance.

Introduction

Modern scientific activity is increasingly based on information obtained from Internet sources, due to their accessibility, prompt dissemination and wide thematic coverage. However, the lack of universal criteria for assessing the reliability of such

sources creates significant risks for the reliability of scientific conclusions. academic research and practical decision-making (Lazer et al., 2018).

Studies show that the application of machine learning algorithms allows for the effective identification of fake news and the assessment of the credibility of sources. For example, Shu et al. (2017) emphasize text analysis, source authority, and fact-checking through reliable references as key factors for assessing reliability. Another approach is proposed by Zhang et al. (2019), which explore the possibility of using blockchain technology to ensure transparency and authenticity of data, which is especially important for combating manipulative information.

Thus, the development of mathematically sound methods for evaluating Internet sources not only contributes to improving the quality of scientific research, but also helps to avoid risks associated with resource expenditure and decision-making based on unreliable data. These approaches become the basis for systematizing the verification of sources and increasing confidence in scientific results.

Ensuring the reliability of information from online sources is a critical task, given the importance of accurate data for scientific research. First of all, it is necessary to implement systematic methods of source verification. This includes the use of machine learning algorithms to detect fake news, analysis of the reputation of publications and authors, as well as fact-checking through cross-references to peer-reviewed publications (Shu et al., 2017). Technologies such as blockchain offer innovative opportunities to ensure data transparency and ensure its authenticity. This is important to prevent manipulation that can distort research results (Zhang et al., 2019).

It is also worth actively using authoritative scientific databases, where articles undergo a rigorous peer review process, which minimizes the risk of spreading false information. For example, resources such as PubMed, Scopus or Web of Science have quality standards that can be adapted to create new systems for assessing the reliability of Internet sources.

Scientific communities should also promote ethical norms for working with information, emphasizing the importance of data accuracy and transparency. In addition, critical thinking skills should be improved in researchers and students to analyze sources and identify potentially manipulative content (Lazer et al., 2018).

The integration of these approaches will not only minimize the risks of using false data in research, but also create a systematized platform to increase confidence in the results of science.

The development of critical thinking is key in the fight against fake information and manipulation on the Internet. For scientists and students, this means the ability to assess the reliability of sources based on a number of criteria: authoritative authority, reputation of the publication, the availability of peer-reviewed articles and factual data confirmed by other studies (Shu et al., 2017). The use of curricula that develop analytical thinking can significantly improve the ability to distinguish between reliable information and manipulative information.

In addition, practical tasks aimed at analysing different types of sources should be implemented, including finding primary sources and fact-checking using authoritative platforms such as Google Scholar, FactCheck.org, or Snopes. Using

fake news cases as educational examples will help you learn how to identify false information in real-world situations (Lazer et al., 2018).

The application of fact-checking technologies is also promising. Automated data analysis services and blockchain can guarantee the transparency and accuracy of information, ensuring the authenticity of content (Zhang et al., 2019). Finally, the development of critical thinking should be accompanied by constant support for ethical norms in working with information to avoid the spread of manipulation or unreliable data.

1. In the modern information environment, Internet sources become the basis for many scientific studies due to their availability and efficiency. However, the lack of uniform standards for assessing the reliability of information creates risks for the quality of scientific conclusions, increasing the danger of spreading manipulative or false information. The use of such data can lead to distortion of academic discourses and significant expenditure of resources. An analysis of existing approaches demonstrates that the use of machine learning algorithms, blockchain technology, and authoritative scientific databases are promising tools for improving the process of assessing the reliability of sources. In addition, the development of critical thinking and ethical standards for working with information among scientists and students provides an additional level of data verification.

Purpose of the study

To develop a mathematically grounded methodology for evaluating Internet sources, which would integrate modern data analysis technologies (machine learning algorithms, blockchain) and consider ethical and critical approaches to assessing the reliability of information. The main task is to create a universal tool that minimizes the risks of using false data, increases confidence in scientific results and ensures optimal use of resources in the decision-making process.

This research lays the foundation for systematizing source verification, increasing the transparency of scientific processes and promoting adaptation to the challenges of the "fake economy".

Methods

Modern innovative methods, such as machine learning algorithms and blockchain, are promising for solving the problem of assessing the reliability of Internet sources. Machine learning can analyse large volumes of texts to identify fake information using neural network models, classification algorithms, and textual characteristic analysis (Shu et al., 2017). Blockchain, in turn, ensures transparency and immutability of data through decentralized fixation of information (Zhang et al., 2019). However, these approaches have certain limitations: complexity in implementation, the need for significant resources, and a potentially high degree of digital hallucinations in machine learning, which can affect the accuracy of the results. In view of these challenges, a simplified and understandable mathematical method is proposed to assess the reliability of sources. This method can be based on multivariate analysis, which uses criteria such as the reputation of the source, which takes into account its history and scientific evaluation (for example, the presence of peer-reviewed publications or cooperation with reputable organizations); cross-

checking, which compares information with other sources on similar topics to identify discrepancies or corroborate; frequency of citations, which analyzes how often the source is mentioned in scientific databases (PubMed, Scopus, etc.); and structural analysis of the text, which reveals potential manipulations through an assessment of the grammar, style and logic of the presentation of the data. This technique is less technically complex but allows you to get an initial assessment of the reliability of the source. It can be easily implemented in educational and scientific environments, providing basic transparency to the analysis process. Thus, the use of simple mathematical approaches combined with innovative methods can provide a flexible and reliable solution to the problem, creating a basis for adaptation to a rapidly changing information environment.

To assess the reliability of each source, various criteria can be used, such as the authority of the source, peer review, relevance of information, etc. Suppose that we evaluate each source on a scale from 1 to 10 according to the following criteria:

1. Authority of the source (A)
2. Peer Review (R)
3. Relevance of information (U)

Then the overall confidence score (T) will be the average of these three criteria:

$$T = \frac{A + R + U}{3}$$

Here is a table with ratings for each source	**Authoritative (A) General**	**Review (R)**	**Current Articles (U)**	**General**
Gartner	9	8	9	9+
McKinsey Company	9	8	9
IDC	8	7	8	8+i
Cisco	9	8	9	9+
Accenture	8	7	8	8+i
Harvard Business Review	9	9	9	9+!
Forbes	8	7	8	8+i

Thus, the general estimates of reliability for each source are as follows:

Here is a list of organizations with their official websites:

1. **Gartner**: www.gartner.com
2. **McKinsey & Company**: www.mckinsey.com
3. **IDC**: www.idc.com
4. **Cisco**: www.cisco.com

5. **Accenture**: www.accenture.com
6. **Harvard Business Review**: hbr.org
7. **Forbes**: www.forbes.com

To develop cybersecurity strategies, it is important to use sources with high reliability, as this ensures the reliability and relevance of information. Based on the reliability assessments, the following conclusions can be drawn:

8. Sources with a score of 8.67 and above:

1. Gartner: 8.67
2. McKinsey & Company: 8.67
3. Cisco: 8.67
4. Harvard Business Review: 9.00

These sources are highly reliable and can be used to develop cybersecurity strategies. They provide reliable and up-to-date information, which is critical for this area.

9. Sources with a score of 7.67:

1. IDC: 7.67
2. Accenture: 7.67
3. Forbes: 7.67

These sources can also be used, but with some caution. They have average reliability and can be useful as additional sources of information. It is recommended to check information from these sources with the help of other, more authoritative sources. Three main criteria were chosen to assess the reliability of Internet sources: authority of the source (A), peer review (R) and relevance of information (U). Source authority assesses an organization's reputation in the professional or scientific community, considering its history, impact on the industry, and recognized expertise. For example, organizations such as Gartner or McKinsey & Company have high credibility due to their years of experience in analysis and consulting in business and technology. Peer review reflects the degree of scientific verification of the information published by the source.(R) For example, Harvard Business Review regularly publishes materials that are thoroughly reviewed by the editorial team, while IDC and Accenture articles are supported by empirical evidence. Sources without rigorous peer review, such as Forbes, receive a lower score on this criterion. Information relevance (U) assesses the relevance of the data provided to current conditions and trends, considering the frequency of updates, responsiveness to new challenges, and relevance of content. Cisco regularly updates cybersecurity data, and Gartner publishes annual analytical forecasts that are widely used in the industry.

Scores (from 1 to 10) were assigned to each source for each of the criteria based on their well-known characteristics. The overall confidence score (T) was calculated as an average using the formula:

$$T = \frac{A + R + U}{3}$$

For example, for Harvard Business Review, authority (A) is rated 9 due to its high reputation among the academic and business communities, peer review (R) is also rated 9 due to rigorous review of materials, and relevance (U) is rated 9 due to regular data updates. Thus, the overall estimate is:

$$T = \frac{9 + 9 + 9}{3} = 9$$

In the case of Forbes, credibility (A) was rated at 8, since it is a well-known business publication, but without a narrow specialization; peer review (R) received a 7 due to the lack of rigorous scientific verification, and relevance (U) was rated 8 for prompt news coverage. Overall rating for Forbes:

$$T = \frac{8 + 7 + 8}{3} = 7.67$$

This approach allows you to identify sources with a high level of reliability that can be used for strategically important research, for example, in the field of cybersecurity. Sources with a score of 8.67 and above, such as Gartner, McKinsey & Company, Cisco, and Harvard Business Review, can be seen as the most reliable. Sources with a score of 7.67, like IDC, Accenture, and Forbes, are recommended to be used as additional, with the obligatory verification of their data using more reputable resources.

Let's conduct a comparative analysis of a reliable and unreliable source using the same methodology. To do this, let's take two sources:

1. Reliable source: Scientific article from a peer-reviewed journal.
2. Unreliable source: A blog or personal website without review.

We evaluate these sources according to three criteria: authority (A), peer review (R) and relevance (U).

Reliable source: Scientific article from a peer-reviewed journal

Criterion and	These are the
Authoritative (A)	10
Peer Review (R)	10
Current Articles (U)	9
Total Eye (T)	$\frac{10 + 10 + 9}{3} = 9.67$

Unreliable source: Blog or personal website

Criterion and	These are the
Authoritative (A)	4
Review (R)	2
Current Articles (U)	5
Total Eye (T)	$\frac{4+2+5}{3} = 3.67$

Conclusion

1. A reliable source (a scientific article from a peer-reviewed journal) has a high overall reliability rating (9.67) and is reliable for use in the development of cybersecurity strategies.

2. An unreliable source (blog or personal website) has a low overall credibility score (3.67) and is not recommended for use in serious research or development of cybersecurity strategies.

Thus, sources with a high reliability score, such as scientific articles from peer-reviewed journals, should be used to develop cybersecurity strategies, and unreliable sources, such as blogs or personal websites without peer review, should be avoided.

Of course, let's do a comparative analysis with real sources, including a specific blog. Let's take two sources:

1. Reliable source: Scientific article from the journal IEEE Transactions on Information Forensics and Security.

2. Unreliable source: A blog on a personal website, such as John's Tech Blog.

We evaluate these sources according to three criteria: authority (A), peer review (R) and relevance (U).

Reliable source: Scientific article from the journal IEEE Transactions on Information Forensics and Security

Criterion and	These are the
Authoritative Articles (A)	10
Peer Review (R)	10
Current Status (U)	9
Common Eye (T)	$\frac{10+10+9}{3} = 9.67$

Unreliable source: Blog on John's Tech Blog

Criterion and	These are the
Autistic Articles (A)	3
Review (R)	2
Current Articles (U)	4
Total Eye (T)	$\frac{3+2+4}{3} = 3.00$

Conclusion by example:

1. A reliable source (a scientific article from the journal IEEE Transactions on Information Forensics and Security) has a high overall reliability rating (9.67) and is reliable for use in the development of cybersecurity strategies.

2. An unreliable source (a blog on John's Tech Blog) has a low overall credibility score (3.00) and is not recommended for use in serious research or developing cybersecurity strategies.

Thus, sources with a high credibility score, such as scientific articles from peer-reviewed journals, should be used to develop cybersecurity strategies, and unreliable sources, such as blogs or personal websites without peer-reviewed, should be avoided

Discussion

The proposed mathematical methodology for assessing the reliability of Internet sources has several significant advantages. Its ease of use makes it easy to adapt the technique to different areas of scientific activity. The universality of the approach contributes to the analysis of both scientific articles and publications on websites, evaluating them according to common criteria. The technique provides a structured approach to analysis, which increases the accuracy of assessing the reliability of sources. An important advantage is the possibility of extending the method by including additional criteria, such as citation index or compliance with interdisciplinary standards. However, the technique also has certain limitations. The main thing is the subjectivity of the assessment of criteria, because different researchers can interpret the level of authority or relevance of the source in different ways. There is also a need to unify assessment scales to ensure maximum objectivity. The complexity of automating the assessment process, especially when working with large amounts of data, is another challenge. In addition, the technique may prove to be less effective for analysing sources in specific industries, which have their own unique requirements for assessing reliability.

Conclusions

The mathematical methodology for assessing reliability is an effective tool for systematizing the analysis of Internet sources in scientific activities. It helps to structure the assessment process, improves the quality of research and reduces the

risks of using inaccurate data. The proposed approach can be adapted to different areas due to its versatility and expandability. Further research can be aimed at automating the assessment, expanding the criteria and adapting the methodology to specific areas of knowledge. Despite certain limitations, the use of this technique contributes to the creation of a basis for increasing the transparency and reliability of scientific processes.

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