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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