Creative AI: The Complex Relationship between Human Inventiveness and Intellectual Property

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CREATIVE AI: THE COMPLEX RELATIONSHIP BETWEEN HUMAN INVENTIVENESS AND INTELLECTUAL PROPERTY

ABSTRACT: In the development of patent law, inventive step has traditionally been viewed as something essentially human. This paradigm is now being challenged by the possibility of using creative AI systems capable of independently generating new inventions: The so-called creative – physical or virtual – programs and robots have therefore triggered a series of considerations that are not easily resolved within the current framework of patent law. Indeed, there is no consensus that machines can be called inventors. In this paper, we will attempt to explore the complex relationship between creation, protection, human inventiveness, and intelligent, creative and interactive robots and AI systems. In particular, we will clarify whether inventions brought about by AI require a complete reassessment of key concepts in patent matters.

KEYWORDS: AI; patents; intellectual property rights; creative and interactive robots; inventorship; creativity

SOMMARIO: 1. Introduction – 2. Intellectual monopolies and AI: a difficult coexistence – 3. What about the inventions entirely generated by AI? – 4. Current praxis and future scenarios – 4.1. Pending question of personhood – 4.2. Alternative solution – 5. Conclusion.

1. Introduction

Developments in Artificial Intelligence (AI) are spreading steadily and ubiquitously, and it is plausible that they will have even greater transformative potential in the near future. AI has entered every aspect of our lives, including creative and inventive activities. It is being used to write newspaper articles and weather or stock market reports, compose pieces of music, create artistic works, and conduct pharmaceutical and medical research, developing innovative technical solutions like true inventors. However, according to the current European orientation[1] (as well

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[1] See, EPO decision of 27 January 2020 on patent applications EP 18 275 163 e on EP 18 275 174.

as in the United States[2] and the United Kingdom[3]), an AI system cannot be indicated as the author of a patent: indeed, protection of creation is legally guaranteed only if it relates to human ingenuity.

However, this rule seems to be challenged by what is called creative and interactive AI. In particular, "interactive robotics"[4] is an emerging field in which robots are designed to perform tasks in close proximity to humans, collaborating with them both physically and cognitively. Despite the strong momentum driving the development of robots and other kinds of AI systems, there is still some resistance to their widespread use in creative and intellectually challenging tasks. One of the biggest obstacles is the lack of specific standards on some key issues, such as intellectual property rights. The need for a clearer legal framework to promote innovation in this sector is confirmed by recent and increasing attention at both the policy[5] and doctrinal levels:[6] all observers agree that this aspect is one of the main obstacles to innovation in this sector.

[2] US Patent and Trademark Office, In re Application No.: 16/524,350 (Decision on Petition) (22 April 2020), available at https://bit.ly/2YMINyo.

[3] UK Intellectual Property Office, Whether the Requirements of Section 7 and 13 Concerning the Naming of Inventor and the Right to Apply for a Patent Have Been Satisfied in Respect of GB1816909.4 and GB1818161.0 (BL O/741/19) (4 December 2019), at URL https://bit.ly/2zCPdYm; the High Court of England and Wales then substantially confirmed this approach in Thaler v The Comptroller-General of Patents, Designs and Trade Marks (2020) EWHC 2412 (Pat).

[4] See, i.e.: M.B. JENSEN, et al., *A Framework for Interactive Human-Robot Design Exploration*, in *International Journal of Architectural Computing,* 18, 3, 2020, 235-253; M. APARICIO et al., *Interactive Robotics and Children's Human Rights*, In: G. RUIZ, M.A. (eds), *Interactive Robotics: Legal, Ethical, Social and Economic Aspects*. *INBOTS 2021*, Biosystems & Biorobotics, 30, Cham, 2022, 174-178; T.B. SHERIDAN, *Human-Robot Interaction: Status and Challenges*, in *Human Factors: The Journal of Human Factors and Ergonomics Society*, 58, 4, 525-532.

[5] See, i.e.: M. IGLESIAS PORTELA, et al., *Intellectual Property and AI — A literature review*, JRC119102, 2021, at URL https://publications.jrc.ec.europa.eu/repository/handle/JRC119102; European Parliament, *Intellectual property rights for the development of AI technologies*, resolution of October 20, 2020 (2020/2015(INI)), at the URL https://www.europarl.europa.eu/doceo/document/TA-9-2020-0277_EN.pdf; EU Commission, *Making the most of the EU's innovative potential — An intellectual property action plan to support the EU's recovery and resilience*, COM, 2020, 760 final, available at URL https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:52020DC0760; J. M. ALLAN et al, *Trends and Developments in AI — Challenges to the Intellectual Property Rights Framework* (Office of the European Union: Final Report, 2020), at URL https://op.europa.eu/en/publication-detail/-/publication/394345a1-2ecf-11eb-b27b-01aa75ed71a1; World Intellectual Property Organization, *WIPO Conversation on Intellectual Property (IP) and AI (AI)* WIPO/IP/AI/2/GE/20/1 REV., Revised Issues Paper, 2020, at URL https://www.wipo.int/edocs/mdocs/mdocs/en/wipo_ip_ai_2_ge_20/wipo_ip_ai_2_ge_20_1_rev.pdf;

[6] See e.g. R. ABBOT, *I Think, Therefore I Invent: Creative Computers and the Future of Patent Law*, in Boston College Law Review, 57, 2016, 1079; J. BALKIN, *The Path of Robotics Law*, California Law Review, 6, 2015, 45; W. BARFIELD, U. PAGALLO (eds), *Research Handbook on the Law of AI,* 2018; E. BONADIO, L. MCDONAGH, *AI as Producer and Consumer of Copyright Works: Evaluating the Consequences of Algorithmic Creativity*, in *Intellectual Property Quarterly*, 2, 2020, 112-137; E. BONADIO, et al., *Intellectual property aspects of robotics*, in *European Journal of Risk Regulation*, 9, 2018, 655–676; B.E. BOYDEN, *Emergent Works*, in *Columbia Journal Law & Arts*, 39, 2016, 377; A. BRIDY, *Coding Creativity: Copyright and the Artificially Intelligent Author*, in *Stanford Technology Law Review*, 2012, 5, 25 2012; R. CALO, et al. (eds). *Robot Law*, 2016; R.C. DENICOLA, *Ex Machina: Copyright Protection for Computer-Generated Works*, in *Rutgers University Law Review*, 69, 2016, 251; T.W. DORNIS, *Artificial Creativity: Emergent Works and the Void in Current Copyright Doctrine*, in *Yale Journal of Law & Technology*, 22, 1, 2020; D.J. GERVAIS, *The Machine as Author*, in *Iowa Law Review*, 105, 2020, 2053; J. GRIMMELMANN, *There's No Such Thing as a Computer-Authored Work – And It's a Good Thing, Too*, in *Columbia Journal of Law & Arts*, 39, 2016, 403; A. GUADAMUZ, *AI and copyright*, in *WIPO Magazine*, 2017; E. HILGEDORF, U. SEIDEL, *Robotics, Autonom-*

In this context, the article intends to address the question of how the intellectual and, in particular, industrial property law should consider the impact of human-robot co-creation on the one hand and autonomous creation by intelligent systems on the other hand in relation to the authorship of intellectual property rights.

Intellectual property protection is indeed fundamental in the field of interactive robotics and AI in general. The rise of interactive robotics and other AI systems that are able to work with humans on intellectual tasks presents another epochal challenge to the law: How should robotic inventions or human-robot collaborations be considered? In other words: If robots and AI are increasingly able to interact intelligently with humans, to the extent that they begin to perform semi-autonomous creative and inventive acts that result in new works and inventions (which may be protected by intellectual property rights), how should such works or inventions be protected? Who should be recognized as the owner of the intellectual property rights? Can AI systems be considered legal subjects in the context of the patentability of inventions that they independently create? And can they be the subject of patent rights at the same time? In particular, the question arises whether such inventions can be protected in some way by patent rights, or whether it is better to leave them in public domain so that the society could benefit from these inventive endeavors that do not reflect human, but artificial creativity? Or should we recognize the AI with some sui generis patent rights? If these patent rights are enforceable, who should be considered the owner of the resulting patent? The programmer? Or the user? The main intellectual property issues are essentially the same whether we are talking about pure and intangible software based on AI or interactive robots equipped with AI and relying on physical embodiment to enhance creativity: in both cases they are not human and, at the same time, are able to (co-)produce results that would be protectable by intellectual property rights, were these results produced by humans.[7]

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ics, and the Law, 2017; M.E. KAMINSKI, *Authorship, Disrupted*, in *UC Davis School of Law — Law Review*, 51, 2017, 589, 593; A. KEISNER et al., *Robotics: Breakthrough Technologies, Innovation, Intellectual Property*, in *Foresight and STI Governance*, 10, 2, 2016, 7–27; A.H. KHOURY, *Intellectual Property Rights for Hubots: On the Legal Implications of Human-like Robots as Innovators and Creators*, in *Cardozo Arts & Ent LJ*, 35, 2017, 635; M. LEMLEY, B. CASEY, *Remedies for Robots*, in *University of Chicago Law Review*, 86, 2019, 1311; D. LIM, *AI & IP: Innovation & Creativity in an Age of Accelerated Change*, in *Akron Law Review*, 52, 2018, 813; E. BONADIO, N. LUCCHI (eds.), *Non-Conventional Copyright: Do New and Non Traditional Works Deserve Protection?,* 2018; J. MCCUTCHEON, *The Vanishing Author in Computer-Generated Works: A Critical Analysis of Recent Australian Case Law*, in *Melbourne University Law Review*, 36, 2013; E. MOKHTARIAN, *The Bot Legal Code: Developing a Legally Compliant AI*, in *Vanderbilt Journal of Entertainment and Technology Law*, 21, 2018, 145; F. PASQUALE, *New Laws of Robotics: Defending Human Expertise,* 2020; N. PETIT, J. DE COOMAN, *Models of Law and Regulation for AI*, in *Robert Schuman Centre for Advanced Studies Research*, Paper No. RSCAS 2020/63, 2020; P. SAMUELSON, *Allocating Ownership Rights in Computer-Generated Works,* in *University of Pittsburgh Law Review*, 47, 1986, 1185; S. YANISKY-RAVID, X. LIU, *When AI Systems Produce Inventions: An Alternative Model for Patent Law at the 3A Era*, in *Cardozo Law Review*, 39, 2018, 2215; S. YANISKY-RAVID, *Generating Rembrandt: 2017 Visionary Article in Intellectual Property Law: Generating Rembrandt: AI, Copyright, and Accountability in the 3A Era-The Human Like Authors Are Already Here — A New Model*, in *Michigan State Law Review*, 2017, 2017, 659, 698; P.K. YU, *The Algorithmic Divide and Equality in the Age of AI*, in *Florida Law Review*, 72, 2020, 331; R. YU, *The Machine Author: What Level of Copyright Protection Is Appropriate for Fully Independent Computer-Generated Works?,* in *University of Pennsylvania Law Review*, 165, 2017, 1245.

[7] In reality, the protection of products created by computer is not completely new. In the U.S., scholars began discussing the potential protectability of computer-generated creativity in the late 1960s. In particular, the U.S.

In the following pages, we will attempt to examine in detail whether robots or AI systems can produce such imponderable results that they can be protected by patents. The aim is to clarify some key aspects and provide answers to these questions by assessing whether the current intellectual property regimes are adequate to the requirements and specificities of intelligent and interactive robotics and AI. Indeed, it is important that intellectual property rights do not become an obstacle to further inventions and innovations in this field. In the light of the above the paper is organized as follows: in the part 2 we address the difficult coexistence between intellectual property-based monopolies and AI by focusing on the essentials of the patent law. In the third part we zoom in the inventions entirely generated by AI and use the Dabus case as an illustration of different visions of its artificial creativity and inventiveness. In the part 4 we deal with the inventions where the humans collaborate with AI and link these collaborations and emerging inventorship questions with the broader question of AI legal personhood and work out a solution to this problematic collaboration. We conclude the paper with a few remarks and observations.

2. Intellectual monopolies and AI: a difficult coexistence

Intellectual property protection is critical in all areas of intensive research and development, and the field of robotics and AI is certainly no exception. In particular, the patent system is the appropriate tool to allow innovators to recoup their investment in research and development. At the same time the patent law aims to guarantee that any output of human creativity and inventiveness after a certain period of time becomes available to whomever wants to benefit from it. Therefore, patent law represents the intersection of private (economic or monetary) and public or social values of innovation,[8] although there is a strong prevalence of utilitarian law and economics-based approaches to intellectual property rights, rather than social and justice-oriented visions.[9] Indeed, it comes as no surprise then that intellectual property rights are more often than not seen as opaque, technical and inconclusively charted,[10] and therefore available and understandable to a few, but inaccessible to the rest of the society.

At the same time, the patent system, when properly designed, also plays a fundamental role in the growth and development of AI systems and in promoting innovation in the robotics industry. In particular, robots, AI systems, and their components can be protected by various intellectual property rights. For example, patents protect inventions and give their owners the right to prevent others from using the patented technology. In particular, the European Patent Convention (EPC) [11] provides

Congress established a committee to determine whether computers or computer programmes could be creators whose results could be copyrighted. See e.g. K.F. MILDE, *Can a Computer Be an "Author" or an "Inventor"?*, in *Journal of the Patent Office Society*, 51, 1969, 378-406.

[8] See O. RIBERO, P. SHAPIRA, *Private and Public Values of Innovation: A Patent Analysis of Synthetic Biology*, in *Research Policy,* 49, 1, 2020.

[9] See, i.e. T. TAYLOR, E. DERCLAYE, *Intellectual Property Rights and Well-Being: A Methodological Approach*, in *Handbook of Intellectual Property Research: Lenses, Methods, and Perspectives*, in I. CALBOLI, M.L. MONTAGNANI (eds), Oxford, 2021, 654-670; J.C. LAI, *The Changing Function of Patents: A Reversion to Privileges*, in *Legal Studies*, 37, 4, 2017, 807-837.

[10] See S. JASANOFF, *The Ethics of Invention: Technology and the Human Nature*, New York and London, 2016, 184.

[11] Convention on the Grant of European Patents, 5 October 1973 revised in Munich on 29 November 2000.

a legal framework for granting patents in the accession countries. In terms of subject matter, the Convention excludes from patentability, among other things, discoveries, mathematical methods, methods of performing intellectual activities, and computer programs, but only to the extent that a patent application relates to these subject matters or activities as such. [12]

For example, computer programs or mathematical methods may still qualify as patentable subject matter, provided they have a technical nature. From this perspective, patents can serve to protect the technical aspect of an AI system or its components, and innovation in this area often comes in the form of new production methods. To benefit from patent protection, an innovation in this field must meet the three basic requirements for patentability[13]: (i) novelty, (ii) inventive steps (the "non-obviousness" in the United States), (iii) industrial application (utility in the United States). The question of patentability of AI systems, on the other hand, is more complex: these systems are factually comparable to mathematical methods and are therefore excluded from patent protection under the European Patent Convention. Patenting of an application or application software is only possible if it produces a so-called "technical effect".[14] Therefore, all inventions that have a technical effect implemented by software, or the so-called "computer-implemented inventions", are patentable.

In general, a "technical effect" is considered to exist whenever the software enables an additional function to be performed compared to the normal interaction with the machine.[15] For example, software that controls the driving system of a vehicle or the autopilot of an aircraft can be patented. On the other hand, an application that merely simplifies some simple tasks such as the preparation of a company's financial statements, the creation of invoices or the organization of an address book cannot be patented. In these cases, it is merely a matter of procedures implemented by software and not of technical effects.

In other words, there are cases where machines perform inventive activities with a significant degree of autonomy and are no longer simple tools for the inventor. This means that there are different levels of participation of these intelligent systems in the invention process: Thus, there are inventions that are exclusively the result of the creative and inventive activity of humans; there are other inventions that involve the use of a computer or other advanced AI system in their execution and where the human creativity is unquestionable; and finally, there are inventions that are made autonomously by intelligent systems and in which the role of humans is really reduced to a minimum. It is in relation to the latter scenario that most of the legal questions on patent law are focused and we deal with these inventions in the part 3. We also identify the fourth kind of inventions, that is inventions where the human-AI collaboration is difficult to distinguish and separate and we dedicate to it some considerations in the part 4.

[12] Convention on the Grant of European Patents, art.52(2) and 52(3).

[13] Cfr. O. MILLS, *Biotechnological Inventions. Moral Restraints and Patent Law*, 2, Furnham, 2010, 4; L. BENTLY, B. SHERMAN, *Intellectual Property Law*, cit., 391.

[14] See art. 52, para. 3, Convention on the Grant of European Patents.

[15] See M. GRANIERI, R. PARDOLESI, *Il Software*, in *AIDA*, 2007, 288-312.

3. What about the inventions entirely generated by AI?

Now suppose that the inventor of a device or object is not a natural person, but an interactive robot or a system with AI. Can a device equipped with AI be cited as an inventor in a patent application? The answer to this question has already been given in the case of a US programmer (Stephen Thaler), the creator of Dabus, "device for the autonomous bootstrapping of unified sentience", who together with the group "The Artificial Inventor Project" has filed several patent applications for the fruits of the machine's autonomous creative efforts.[16] In particular, the European Patent Office (EPO) was prompted by a request for registration to examine whether this AI system could be cited as an inventor in a patent application and decided in the negative.[17] Similar decisions on the same registration request were made by the United Kingdom Intellectual Property Office[18] and by the United States Patent and Trademark Office.[19]

However, a different story took place in Australia. The Deputy Commissioner of Patents followed the US and EU patent offices' approach and rejected the invention which author was Dabus. Dabus's creator Steven Thaler did not see it that way and presented the case to the court, arguing that Dabus should be recognized as an inventor. The court agreed with Steven Thaler and argued that the AI could be an inventor because "First, an inventor is an agent noun; an agent can be a person or thing that invents. Second, so to hold reflects the reality in terms of many otherwise patentable inventions where it cannot sensibly be said that a human is the inventor. Third, nothing in the Act dictates the contrary conclusion."[20] Indeed, according to this judgement, the fallacy comes when we make a confusion on who can be an inventor on the one hand and who can be an owner, a controller or a patentee on the other hand. The owner, controller or patentee can be either a human or a legal person, but that does not mean — and this is where the fallacy comes into play — that the inventor can only be a human: AI can be an inventor, yet it cannot be owner, controller or patentee. Indeed, the judge asks "Why cannot our own creations create?" and invites to look at the concept of inventor in "a flexible and evolutionary way" so much so because "computer inventorship would incentivize the development by computer scientists of creative machines, and also the development by others of the facilitation and use of the output of such machines, leading to new scientific advantages."[21]

In any event, this opening to the idea that AI can be an inventor did not last, as the Deputy Commissioner of Patents appealed the decision and brought the case in front of Federal Court of Australia, who decided in favor of Commissioner and rejected the decision to grant inventor's status to Dabus.[22]

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[16] See The Artificial Inventor Project, at the URL https://artificialinventor.com/.

[17] On this point, see EPO decision of 27 January 2020 on patent applications EP 18 275 163 e on EP 18 275 174.

[18] UK Intellectual Property Office, Whether the Requirements of Section 7 and 13 Concerning the Naming of Inventor and the Right to Apply for a Patent Have Been Satisfied in Respect of GB1816909.4 and GB1818161.0, cit. Cfr. Thaler v The Comptroller-General of Patents, Designs And Trade Marks (2020) EWHC 2412 (Pat).

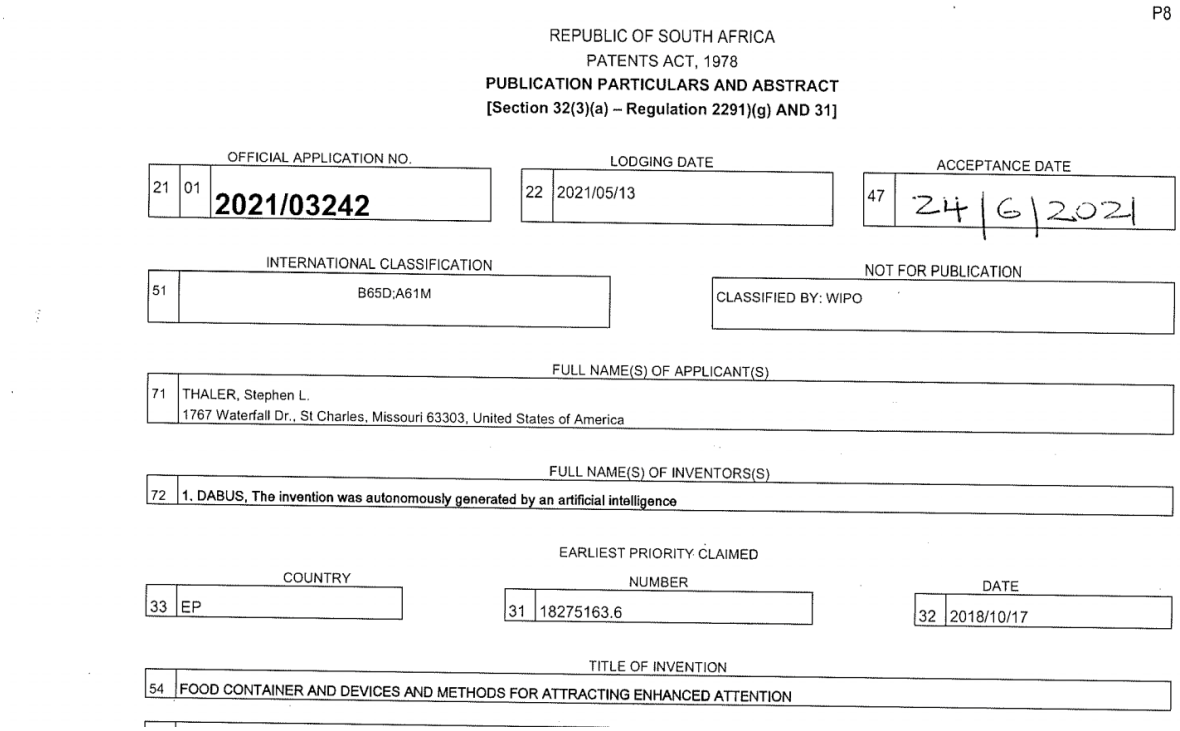
[19] US Patent and Trademark Office, In re Application No.: 16/524,350 (Decision on Petition) (22 April 2020), *cit*.

[20] Thaler v. Commissioner of Patents [2021] FCA 879, https://artificialinventor.com/wp-content/uploads/2021/08/Thaler-v-Commissioner-of-Patents-2021-FCA-879.pdf

[21] S. JASANOFF, *Ethics of Invention*, cit., 206.

[22] Commissioner of Patents v Thaler [2022] FCAFC 62, https://www.jade.io/article/912670.

The only patent office — officially called the Companies and Intellectual Property Commission — that so far has recognized Dabus as inventor is that of South Africa, whose patent laws do not define the inventor, nor the patent granting system includes substantive examination of patent applications. Figure 1 shows the patent application that was submitted and accepted by South African patent authorities and represent the historical recognition of Dabus as an inventor.



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REPUBLIC OF SOUTH AFRICA
PATENTS ACT, 1978
PUBLICATION PARTICULARS AND ABSTRACT
[Section 32(3)(a) – Regulation 2291)(g) AND 31]

OFFICIAL APPLICATION NO.	LODGING DATE	ACCEPTANCE DATE
21 01 **2021/03242**	22 2021/05/13	47 24/6/2021

INTERNATIONAL CLASSIFICATION	NOT FOR PUBLICATION
51 B65D;A61M	CLASSIFIED BY: WIPO

FULL NAME(S) OF APPLICANT(S)
71 THALER, Stephen L.
1767 Waterfall Dr., St Charles, Missouri 63303, United States of America

FULL NAME(S) OF INVENTORS(S)
72 1. DABUS, The invention was autonomously generated by an artificial intelligence

EARLIEST PRIORITY CLAIMED

COUNTRY	NUMBER	DATE
33 EP	31 18275163.6	32 2018/10/17

TITLE OF INVENTION
54 FOOD CONTAINER AND DEVICES AND METHODS FOR ATTRACTING ENHANCED ATTENTION

Figure 1. First recognition of Dabus as an inventor by South African patent authorities

These two cases, that took place outside EU and USA, support the idea that our understanding of who can invent is starting to be questioned from a variety of perspectives. "The idea of the lone ingenious inventor that animated eighteenth-century Western intellectual property law seems too limited to handle the complex claims of ownership that grow out of the twenty-first century's highly distributed knowledge systems"[23] and Dabus is as good example of this as any other AI system that has gone beyond our understanding of what tools can and cannot do.

Coming back to Europe, the EPO's decision to deny the inventorship claims of Dabus is to be understood in particular to the effect that AI systems do not have legal personality and therefore cannot be named as inventors in a patent application.[24] Thus, the designation of the inventor is a mere formality which provides for the identification of one or more persons with their full first name and surname as well as country and place of residence (which can be interpreted to mean that the inventor must be a natural person), so that the European Patent Office - as provided for in the Implementing Regulation to the European Patent Convention - does not verify the correctness of the designation of

[23] S. JASANOFF, *op.cit*., 204.

[24] See the arts. 62, 81 and 90 EPC and the Rule 19 of Implementing Regulation of the European Patent Convention (EPC 2000).

the inventor.[25] The designation of an inventor as a "natural person" was therefore considered mandatory, but only as a formal requirement from which legal consequences may also arise, not as a fundamental requirement for the validity of the patent. In other words, the European Patent Convention does not explicitly exclude from patentability an inventive achievement generated by an AI system, so that the way in which an invention was made is irrelevant.[26] This interpretation is supported by the combined provisions of Articles 27 of the TRIPS Agreement[27] and 52 of the European Patent Convention,[28] both of which state that patents should be granted without discrimination in the field of technology.

On the definitional level, neither the European Patent Convention nor most national laws of member countries provide a detailed definition of the term "inventor". Thus, the Convention merely states that the right to a patent belongs to the inventor or his successor in title.[29] In addition, as mentioned above, the Convention provides that the inventor must be named in the application with his or her first name, surname and address, which can be interpreted to mean that the inventor must be a natural person. In support of this thesis, national courts and legislatures in Europe have repeatedly linked the concept of inventor to that of contribution to inventive achievement.[30]

For example, in the United Kingdom, section 7 of the Patents Act of 1977,[31] called "Right to apply for and obtain a patent", states that any "person" can apply for a patent either individually or jointly with others; it is also specified that the term "inventor" refers to the "actual inventor" of the invention; finally, in section 13 (2) it is specified that the applicant must designate the "person" who is considered the inventor.[32]

In German law, inventor is also not defined in the law, but the courts have interpreted the concept of inventor as the person who, taking into account the entire content of the patent application, has cre-

[25] See Rule 19, Implementing Regulation of the European Patent Convention (EPC 2000).

[26] See J.M. ALLAN et al, *Trends and Developments in AI — Challenges to the Intellectual Property Rights Framework*, *cit*., 100; R. HUGHES, *EPO refuses "AI inventor" applications in short order - AI Inventor team intend to appeal*, IP Kat Blog 22 December 2019, alla URL https://ipkitten.blogspot.com/2019/12/epo-refuses-ai-inventor-applications-in.html; P. BLOK, *The Inventor's New Tool: AI – How Does it Fit in the European Patent System?*, in *European Intellectual Property Review*, 39, 2017, 69.

[27] Art. 35, Agreement on Trade-Related Aspects of Intellectual Property Rights, Apr. 15, 1994, 1869 U.N.T.S.299 (TRIPS Agreement).

[28] European Patent Convention, art.52.

[29] See Art. 60(1), according to which: "he right to a European patent shall belong to the inventor or his successor in title. If the inventor is an employee, the right to a European patent shall be determined in accordance with the law of the State in which the employee is mainly employed; if the State in which the employee is mainly employed cannot be determined, the law to be applied shall be that of the State in which the employer has the place of business to which the employee is attached."

[30] On this, see, R.M. BALLARDINI, K. HE, T. ROOS, *AI-Generated Content: Authorship and Inventorship in the Age of AI*, in T. PIHLAJARINNE et al. (eds), *Online Distribution of Content in the EU*, 117, 128, Cheltenham, 2019 (the authors observe: "To date, there is no case law handed down by the EPO Boards in relation to the interpretation of the concept of 'inventor'. However, some EU national courts have passed down a set of relevant court decisions on the matter").

[31] Cfr. U.K. Patents Act 1977, section 7(1) e 7(3) (as amended).

[32] *Ibidem*, section 13(2).

atively contributed to the subject matter of the patent itself.[33] In France, the patent law also does not contain a definition, but the inventor is considered to be the person who conceived and created the invention.[34] In Italy, there is also no definition. According to the wording of the Italian law, any subject (natural or legal person) who is entitled to the inventive step that led to the invention is entitled to apply for a patent. In particular, Article 21 of the Implementing Regulation to the Industrial Property Code stipulates that the patent application must also contain the surname, first name, nationality and residence of the natural person or the name, seat and nationality of the applicant legal person or entity. [35] Curiously, in Lithuania the inventor is defined as "a physical person who created the invention"[36] and therefore, at least in this Baltic state, the inventor can only be a natural person. However, this is an exception, rather than a rule within the EU.

Thus, generally speaking, it could be argued that inventions should be considered patentable even if they are generated autonomously by AI systems. On the contrary, the problem might arise at the level of national law, because the applicable laws of a number of member states of the European Patent Convention explicitly require the attribution of the invention to a natural person.

4. Current praxis and future scenarios

Currently, there are already many areas in science and technology where automated machines or robots are involved in creative and inventive processes. For example, DNA sequencing machines provide researchers with information that can, of course, later be patented. There is a difference here, of course, because such machines are automated and not capable of autonomous discovery and learning tasks, and many of the inputs to such systems are provided and selected by humans. Moreover, the data and results that emerge from these processes are subsequently analyzed and reviewed by humans. Inventions supported by AI are certainly the most relevant phenomenon at present. Given the current state of AI-based technologies, the possibility of a system being able to make inventions that are not causally related to one or more human inventors seems to be a future or very limited reality in current practice. Nevertheless, it must be kept in mind that there are also many AI systems that appear to have independent hypothesis generation and testing capabilities, which in patent parlance might lead to independent invention by the intelligent system, i.e., without any direct action by humans.[37] The question here is whether the owner, user, or programmer of the robot or an AI system is entitled to patent protection for an invention developed directly by AI.

[33] On this point, see what is reported from R.M. BALLARDINI, K. HE, T. ROOS, *AI-Generated Content: Authorship and Inventorship in the Age of AI*, cit., 128.

[34] *Ibidem*.

[35] See art. 21, Regolamento di attuazione del Codice Proprietà Industriale (Decreto Legislativo 13 gennaio 2010, n. 33).

[36] See 1st skirsnis of Lietuvos Respublikos Patentų Įstatymas (Nr.1-372, January 18, 1994), available at https://www.e-tar.lt/portal/lt/legalAct/TAR.07786E0929A8/asr

[37] See R. ABBOTT, *I Think, Therefore I Invent: Creative Computers and the Future of Patent Law,* in *Boston College Law Review*, 57, 2016, 1079, 1083 (The author emphasises that the use of intelligent systems in invention processes has been widespread for some time and will continue to increase); see also P.H. BLOK, *The inventor's new tool: AI — how does it fit in the European patent system?,* in *European Intellectual Property Review*, 49, 2017, 69.

It is therefore very likely that in recent years many patent offices have actually granted patents for products created by AI or with a relatively small degree of human involvement, without knowing that in fact a machine was the author of the invention: presumably this is done to avoid litigation over the absence of a human inventor.[38] Rather than indirectly encouraging such unethical practices, patent offices should probably introduce requirements that force applicants to be transparent and to explain — for example, in describing the technical problem and its solution — the role that AI systems played in the invention process: to this end, patent applicants should be required to disclose the role of an AI-driven system in the processing of the subject matter to enable a proper assessment of patentability.[39] If inventions resulting from the use of AI systems were not patentable, this would have the perverse effect of encouraging inventors in this sector to use trade secrets instead of patents to protect their activities. In this case, there is a risk that the progress of innovation in this sector would be significantly slowed down.

It follows that on a purely literal level — even though the possibility of an AI system being able to make inventions that are not causally related to a human inventor or inventors is currently a long way off — there is certainly a regulatory vacuum that needs to be filled: this is especially true given the speed at which AI systems are evolving. Machines that are able to match humans in every respect seem to belong to a future that, even if it is a long way off, is certainly closer than we think.

Indeed, the question of who (or what) can invent is just one of the parts of the bigger question that we briefly refer to in the following section: the question is that of legal personhood of machines. Because the arguments we make for or against the recognition of authorship of invention or work of art conflates into arguments on who or what counts as a subject (or person) in law.

4.1. Pending question of personhood

As AI systems become more sophisticated and will be able to play a larger role in society, it will inevitably be necessary to address various topics (not only limited to the issue of authorship of intellectual property rights) also related to the recognition of some form of distinct legal personhood. Until recently, such arguments were purely speculative.[40] But institutions and policymakers are increasingly

[38] See E. BONADIO, et al., *AI as inventor: exploring the consequences for patent law,* in *Intellectual Property Quarterly*, 2021, 48, 61.

[39] See R. ABBOTT, *Everything Is Obvious*, in *U.C.L.A. Law Review*, 66, 2, 2019, 7 (The author believes that patent offices should introduce a new obligation for applicants to disclose when a machine contributes to the design of an invention. In fact, applicants are already required to disclose all human inventors, and failure to do so could result in a patent being invalid or inapplicable. Similarly, it should be clarified whether a machine performs an activity comparable to that of a human inventor); E. STANKOVA, *Human inventorship in European patent law*, in *Cambridge Law Journal*, 80, 2021, 338 (For example, the author proposes to introduce an obligation to disclose whether and to what extent an AI-based system has been used and to describe the stages of the process carried out by that system. If an applicant does not explain these steps and their significance, the EPO may reject the application under Article 90 EPC because it does not meet the formal patentability requirements).

[40] However, it is interesting to mention two real cases: In October 2017, Sophia became the first robot to be granted citizenship by the Saudi Arabian government. This step was probably an event to attract public attention. Nonetheless, it is a historic step toward the possible assimilation of AI and humans. Just a month later, in November 2017, Tokyo granted a chatbot official residency status in the Shibuya district. See E. ROCHA, *Sophia: Exploring the Ways AI May Change Intellectual Property Protections*, in *Journal of Art, Technology & Intellectual*

questioning the nature and fate of these new technologies in order to adapt existing law to these changes: for example, the European Parliament a few years ago adopted a resolution calling on the European Commission to consider of "creating a specific legal status for robots in the long run, so that at least the most sophisticated autonomous robots could be established as having the status of electronic persons responsible for making good any damage they may cause, and possibly applying electronic personality to cases where robots make autonomous decisions or otherwise interact with third parties independently."[41] Inasmuch as this resolution was criticized, it started a debate that seems to be impossible to ignore.[42]

Indeed, since this resolution and regardless the critical voices, many alternative ideas and solutions have been put on the table as concerns the legal personhood of machines. The suggestions are numerous: from partial legal capacity or *Teilrechtsfähigkeit*[43] to personalized and specific legal personhood to concrete AI,[44] from AI citizenship[45] to legal personality of AI as an independent commercial actor[46] to those who propose to abandon the idea of personhood of AI altogether.[47] As noted by the philosopher Hilary Putman – before anyone else could even think about it – one of the most interesting challenges is precisely that relating to the evaluation and definition of the opportunity to give some form of legal personality to intelligent systems.[48] From a legal point of view – as has already been done in other situations – there is certainly the possibility of granting legal personality to any abstract or non-physical entity regardless of the characteristics of ontological subjectivity: therefore it does not seem in doubt that most legal systems can grant some form of personality to AI systems. Rather, it is necessary to ask whether it is really necessary and what could be the content of such a personality. [49]

Property Law, 28, 2, 2018, 126–146; A. CUTHBERTSON, *Tokyo: Artificial Intelligence 'Boy' Shibuya Mirai Becomes World's First AI Bot to Be Granted Residency*, in *Newsweek*, Washington, available at https://www.newsweek.com/tokyo-residency-artificial-intelligence-boy-shibuya-mirai-702382

[41] See § 59 (f), European Parliament resolution of 16 February 2017 with recommendations to the Commission on Civil Law Rules on Robotics (2015/2103(INL)), OJ C 252, 18.7.2018, 239–257.

[42] One of the most critical sources to this resolution came from the open letter of more than 150 experts and scholars who have opposed the possibility of electronic personhood of intelligent robots by arguing that ethically and legally such personhood is not acceptable regardless legal status model – natural person, legal entity or Anglo-Saxon trust model – that could be used for intelligent robots. The letter is available at http://www.robotics-openletter.eu/.

[43] D.M. MOCANU, *Gradient Legal Personhood of AI Systems – Painting Continental Legal Shapes Made to Fit Analytical Molds*, in *Front Robot AI*, 8, 2022.

[44] J. CHEN, P. BURGESS, *The Boundaries of Legal Personhood: How Spontaneous Intelligence Can Problematise Differences between Humans, AI, Companies and Animals*, in *Artificial Intelligence and Law*, 27, 2019, 73-92.

[45] See T.L. JAYNES, *Legal Personhood for AI: Citizenship as the Exception of Rule*, in *AI & Society*, 35, 2, 2020, 343-354.

[46] See V.A.J. KURKI, *A Theory of Legal Personhood*, Oxford, 2019; in particular, see chapter 6 — The Legal Personhood of AIs, 175-189.

[47] See, for example, E. MIK, *AI as a Legal Person*, in J.A. LEE, R. HILTY, K.C. LIU (eds), *AI and Intellectual Property*, Oxford, 2021, 419-438.

[48] See H. PUTNAM, *I robot: macchine o vita creata artificialmente?,* in *Mente, Linguaggio e Reltà*, Milano, 1987, 416-438 (the author already wondered in 1960 whether it was right that robots had civil rights).

[49] See S. CHESTERMAN, *AI and the limits of legal personality*, in *International and Comparative Law Quarterly*, 69, 2020, 819.

Moving onwards in this debate, the interesting issue related to AI legal personhood is the specific rights that it could be granted with. Perhaps the experience with granting rights to other non-human entities, such as corporations and animals, is problematic[50] and prevents those who at least theoretically accept the idea of legal personhood of machines to even consider the possible particular list of rights that could be granted to AI. In the following section dedicated to alternative solution to inventorship problem related to AI, we — among other things — also advance a few ideas of what rights could be specified thanks to the advancements or changes in our understanding of legal authorship and inventorship. The underlying and implicit question is whether the debates on inventorship that we are currently dealing with are not just the legal questions, but much more complex questions that anticipate the paradigmatic and profoundly complex social, legal, political and economic changes that the AI is going to produce: in other words, is patent law debate on inventorship foreshadowing the twilight of legal institutions and systems — legal Götterdämmerung?—as we know them? Is the patent law the legal branch that will push forward the bottom-up approach to recognizing rights and personality to AI, as the top-down approach — approach adopted by the EU Parliament in its resolution[51] — has failed to do so?

4.2. Alternative solution

Having seen that being recognized as inventor has further repercussions on our understanding of AI's legal status, we now move on to ask a different question, namely, if we do not (yet?) consider the contribution of AI to the inventive endeavors of humans relevant enough to be recognized legally, what other ways could there be to distinguish the completely human inventions from those inventions where human inventive effort to a certain extend has been lesser and where human creativity has been boosted with the help of AI? Indeed, in the previous sections we have analyzed the proposal that human creators should inform the patent offices of the use of AI in their creative and inventive results,[52] but are there — or should there be — any other solutions?

Such inventions where human and AI collaboration in creating an invention is not possible to distinguish meaningfully, could be protected for lesser time, similarly to the way we protect utility models. This opens up the debate on what is meaningful in human-AI interaction and how do we understand it from a patentability perspective. The question on the meaning of meaningfulness has already surfaced in a variety of discussions related to other technologically-challenging legal domains, such as the autonomous weapons or privacy protection.[53] In the context of patent law debate, a meaningful

[50] Among many on corporations, see J. D. CLEMENTS, *Corporations are not People: Reclaiming Democracy from Big Money and Global Corporations*, San Francisco, 2014; and A. WINKLER, *We the Corporation: How American Businesses Won Their Civil Rights*, New York and London, 2018. As concerns animals, see among many, G.L. FRANCIONE, *Animals as Persons*, New York, 2008.

[51] European Parliament resolution (2015/2103(INL)), *op.cit*.

[52] See R. ABBOTT, *Everything Is Obvious*, *cit.*, 2019.; E. STANKOVA, *Human inventorship in EU patent law*, *op. cit.*, 2021.

[53] Cfr. D. AMOROSO, G. TAMBURRINI, *Autonomous Weapons Systems and Meaningful Human Control: Ethical and Legal Issues*, in *Current Robotics Reports*, 1, 2020, 187-194, (the author advances the idea that meaningful control over autonomous weapons has a threefold role as a fail-safe actor, accountability attractor and moral agency enactor); A. SELBST, J. POWLES, *Meaningful Information and the Right to Explanation*, in *International Data Privacy Law*, 7, 4, 2017, 233-242, (the authors address the data subject right to the meaningful information

distinction could be the one where the contributions of human inventor and AI are possible to identify and the human inventor is able to explain where and how his inventive endeavor took place and whether it could have taken place without the assistance of or collaboration with the AI. In case the invention could be patentable even without the collaboration with AI, although this collaboration took place, then the patent could be granted for the same period as if the AI was not involved at all. In case the invention could not exist without AI collaboration with human inventor, then we would talk about not distinguishable collaborations.

In fact, in those cases when we are dealing with indistinguishable collaborations among humans, patent law usually refers to the joint inventorship. In case of indistinguishable human-AI collaboration — that could be discovered through the patent claims presented to the patent office — this difference in our conception of joint inventorship could be reflected not that much in attributing AI with co-inventorship, but rather in the shorter term of patent protection. This shorter time protection could at the same time also help to preserve the exclusivity of human inventorship as it would not relate to AI as to inventor.

The question is what might be the benefit for the human inventor to recognize the support of AI in the inventive process: if this collaboration is kept secret, the human inventor could claim a full patent protection period (25 years). However, the benefit of disclosure of collaboration with AI could reside in making the market of patented inventions more flexible and dynamic and encourage the human inventors — who would keep the economic rights of patents — to invest and foster development of creative and interactive AI and robots and would also save resources that the companies and individuals have to invest in defending their patents from infringements by competitors.[54]

Another solution is to recognize the collaborative effort amongst human and AI and grant AI with inventorship, which excludes — as already mentioned above — the economic benefits, but provides with a recognition that certain part of creative endeavors took place in a machine and were not completely human-generated. In this way, we would preserve the economic side of patent granting to a human, but at the same time recognize that the patented invention is not completely human and (just a little bit) open up the door to legal personhood of AI. Again, why should we do that? We could do that for several purposes: first of all, because of intellectual honesty and coherence: we would not attribute ourselves the inventions in which we took part but did not completely cause the invention itself. Secondly, we could contribute to the recognition of non-human creativity and show that such creativity could be beneficial for the rest of society once the patent protection expires. Thirdly, recognizing AI as an inventor would also show the importance of technological advancements for human creativity and support the human-AI collaborations that challenge the contemporary antagonistic vision of them (machines) versus us (humans).[55]

about the logic involved in the algorithmic decision-making as referred to by General Data Protection Regulation).

[54] Cfr. W.M. LANDES, R.A. POSNER, *The Economic Structure of Intellectual Property Law*, Cambridge, Massachusetts and London, 2003; A. MARCO et al., *Do Economic Downturns Dampen Patent Litigation?*, in *Journal of Empirical Legal Studies*, 12, 3, 481-536.

[55] See for instance K.T. BOCHNIARZ et al., *Attitudes to AI among High School Students: Understanding Distrust Towards Humans Will not help us Understand Distrust towards AI*, in *Personality and Individual Differences,* 185, 2022; available at https://www.sciencedirect.com/science/article/pii/S0191886921006784; S.C. ATHEY et

In the light of this third reason, the possibilities for recognition of legal personhood to AI and interactive robots could become more viable: as already mentioned previously, the bottom-up approach based on patent law recognition of inventorship of AI — as limited as this recognition in moral terms might be and as inconsequential from the economic perspective it necessarily will be — it still provides us with the first attempts to critically address and scrutinize again our understanding about what and who matters as subjects in law.

5. Conclusion

Modern patent law has to cope with the increasing prevalence and importance of AI-based systems in the development of new technical solutions. It is therefore obvious that it is necessary to prepare for the challenge of the future, which is characterized by systems capable of carrying out inventions in a fully autonomous manner with regard to so-called co-creation: As part of a renewal of patent law, it would be desirable to address the current limitations in the systems of examination, evaluation and transfer of intellectual property rights. In his book, "The Reasonable Robot", Ryan Abbott argues that the law should not distinguish between humans and AI when they perform the same tasks. [56] As AI increasingly supplants human intelligence in many fields, it should be treated as a human. [57] In particular, the increasingly sophisticated use of systems based on AI risks raising the threshold for patentability to the point where many inventive activities become theoretically obvious and require the development of new requirements and systems to protect intellectual property. [58]

As noted by other authors, intellectual property law is by no means compelled to adhere strictly to a doctrine of human exclusivity: This is especially true in the area of patent law, where patentability is based on the objective value of an invention rather than the subjective efforts or personal circumstances of the inventor. [59] Patent offices may therefore soon be asked to consider new requirements to better define the contribution of machines to the invention. The future is just around the corner and the debate about it has only just begun.

Furthermore, the question of inventorship in patent law represents an alternative, bottom-up approach to AI legal personhood which sooner rather than later will be necessary to deal with. Patent law, that protects the result of inventive effort but not its source or origin, is functional in advancing recognition of rights to non-human creators, who should be recognized as creators nevertheless. Perhaps patent law is much more than inventions and patents: maybe patent law is about revolution of legal thought, about inventing and placing the new legal persons within the current legal system and about anticipating and legalizing unavoidable changes in our understanding of who or what can

al., *The Allocation of Decision Authority to Human and AI*, in *NBER Working Paper Series,* Working Paper 26673, 2020; available at https://www.aeaweb.org/articles?id=10.1257/pandp.20201034#:~:text=The%20 allocation%20of%20decision%20authority%20by%20a%20principal%20to%20either,effort%20in%20learning%20choice%20payoffs.

[56] See R. ABBOTT, *The Reasonable Robot*, 2020.

[57] *Ibidem*.

[58] *Ibidem*.

[59] See T.W. DORNIS, *Of "authorless works" and "inventions without inventor" — the muddy waters of "AI autonomy" in intellectual property doctrine*, in *European Intellectual Property Review*, 43, 2021, 570, 585.

create and invent. Lastly, there is one more crucial element. Current legal discourse focuses mostly on the output created by artificial intelligent systems. There is essentially little consideration of the legal issues surrounding the management of intellectual property rights in connection to inputs. Indeed, machine learning relies heavily on vast quantities of training data. Some businesses already have access to this information. Typically, these are existing businesses in a distinct industry; nonetheless, new entrants must create or license databases containing this training data. While some huge data sets are just data, or non-protectable information (such as market prices or raw data for weather AI), the great majority of training data sets are massive collections of intellectual property-protected works. The question that remains unanswered is whether and under what conditions it is permissible to utilize these works.

ISSN 2284-4503