

AI-Generated Content: Authorship and Inventorship in the Age of Artificial Intelligence

Authors: Rosa Maria Ballardini, Kan He & Teemu Roos

1. Introduction

Predicting the future of technology is notoriously difficult. Indeed, predicting how law and regulation should be shaped to meet the needs of future technological developments is a task that might often lead to hilarious predictions.¹ The difficulty in predicting technological development is certainly reflected in the current debate about the future of artificial intelligence (AI). Within this framework currently two extremes can be identified: those who view AI as a path towards ‘superintelligence’ that transcends humanity, and those who think AI is merely a glorified version of data analysis and statistical inference. In any case, it seems realistic to foresee that in the near future there will be an increase in machines that are able to perform more tasks in more efficient and autonomous ways than we currently can envision. These tasks include the production of artistic, technological, and scientific innovations that might potentially be protectable via intellectual property (IP) laws. Because of the economic value of these innovations there may be an interest in ‘controlling’ such intellectual creations via intellectual property right (IPRs). In this context, a key question relates to how to interpret the concepts of ‘authorship’ (copyright) and ‘inventorship’ (patents) of creations and inventions generated by AI systems.

IPRs aim at protecting the fruits of the human mind. IPRs are a set of limited exclusive rights allocated to ‘persons’, either natural or legal. As such, traditionally, both copyright and patent laws in Europe have relied upon the concept of author or inventor as a natural person. Indeed, such an idea is reflected not only in the legal definitions of author and inventor, but also in concepts like ‘work’ and ‘invention’, as well as in the requirements necessary to acquire protection. By possibly allowing production of innovations in an ‘autonomous’ way, AI naturally challenges these traditional well-established legal notions. Can an AI-generated work or invention attract IPR protection under current rules? Is there a need to shape our understanding and interpretation of authors and inventors as natural persons in view of rapidly expanding AI? What would be the benefits and what the consequences of such shift?

The chapter focuses on the concepts of authors and inventors for AI-generated innovations as prerequisites for copyright and patent protection. The issue is important not only because authors and inventors have ownership rights in their copyright or patent, but also (and more fundamentally) because if there is no legitimate author or inventor, the IPR might either not be granted in the first place or held invalid or unenforceable in court. The chapter begins by explaining some fundamental technological concepts of AI and by providing examples of AI-generated outputs that can potentially attract IPR protection. The second part explores copyright and patent

¹ E.g. the prediction by CONTU that “[Electronic distribution] may ease the problem which has been caused by the wide availability of photocopying machines capable of producing copies quickly and relatively inexpensively”. (CONTU, United States 1979: 78).

related issues in the context of AI, with focus on the currently existing concepts of authorship and inventorship in European copyright and patent laws. Thirdly, the chapter discusses possible needs, as well as consequences, for opening possibilities to non-human authors or inventors. The whole discussion is contextualised and pondered within the framework of justifications for IPRs: we address the issue of authorship and inventorship rights on AI-generated innovations via a theoretical discussion about IPR protection and access. This allows us to argue in favour of a ‘modernist’ type of school, which follows a balanced approach between protection and access. We conclude in favour of the inclusion of a legal provision stating that only ‘natural’ persons can be deemed as authors/inventors and that only the natural person(s) behind the arrangements necessary for the creation or invention at stake should be considered as the author or the inventor.

2. What do we mean by “AI-generated”?

According to Russell and Norvig, AI is “the study of agents that exist in an environment and perceive and act”². Schalkoff defines AI as “[a] field of study that seeks to explain and emulate intelligent behavior in terms of computational processes.”³ The latter definition highlights the importance of emulation and behavior. In fact, often when we observe the behavior and products of AI systems without being aware of their internal working – as if they were ‘black boxes’ that we cannot open – we may be tempted to use words such as *perceive* and *think*. Yet, when the workings of the systems are revealed to us in the form of an algorithm and code, or the principles underlying them, we may prefer to use more mechanical terms such as *input* and *process*.⁴

The distinctive feature of AI systems compared to other software systems is their higher degree of autonomy. To better explain the significance of this feature for the present discussion, let us first discuss some examples of familiar tools for artistic creation. A word processing system, even if it is helpful in creating a novel, has very little to do with the end result (the novel) and the user of the system is the author of the novel. In other words, such a system is clearly a simple tool that can be compared to a paint brush. Different tools may be necessary to create different products, but the user (author) is still responsible for the creative contribution to produce any given result.

The opposite extreme is a system that allows the user to choose between a small set of possible outcomes. Consider for example systems used for creating avatars⁵ on computer gaming platforms such as Microsoft Xbox or Sony PlayStation: the user gets to choose the height and weight of the avatar, as well as its (his/her) gender, hairstyle, hair color, and various other features. The system basically involves a sequence of multiple choice questions, and even though different choices lead to markedly different outcomes, the creative contribution of the user is negligible

² S. J. Russell and P. Norvig, *Artificial Intelligence: A Modern Approach* (Pearson, 3rd edn, 2010).

³ R. Schalkoff, *Artificial Intelligence: An Engineering Approach* (McGraw-Hill, 1990).

⁴ Indeed, a third definition of AI is “AI is whatever hasn't been done yet”, quote attributed to Larry Tesler; see (D. Hofstadter. *Gödel, Escher, Bach: an Eternal Golden Braid* (Basic Books, 1979)).

⁵ “In Computing, an avatar is the graphical representation of the user or the user's alter ego or character”, Wikipedia: Avatar (computing), retrieved February 9, 2018.

compared to the contribution of the artists who design the visual appearance of the different elements (body, face, clothing).

There is a continuous spectrum between tools in the paint brush category, including word processing systems, and those in the “avatar” category. Many AI systems are somewhere in between these two extremes: they require significant user input but they also significantly guide and affect the outcome.

Yet another critical aspect in many AI systems, especially those based on machine learning, is data. Machine learning is a subdiscipline of AI that can be defined as the study of algorithms and systems that improve their performance on a given task as they are provided with more data.⁶ The performance of AI systems based on machine learning relies critically on the quality of the data. Thus, the role of the data provider also needs to be acknowledged. To continue the avatar example, the system could extract the graphical elements that it uses to create the avatars from a third-party data source such as photographs or paintings that were not necessarily originally intended to be used as parts of avatars.

The following table includes a set of examples of currently existing AI systems that are challenging the notions of author and inventor.

Name	Category of IPR	Description
Next Rembrandt ⁷	Copyright	By analysing the statistical properties of known Rembrandt paintings on the level of high resolution photographs and depth images, a new painting was produced by 3D printing. The painting had similar properties as the Rembrandt paintings but it was clearly a new painting in the sense that it wasn't a copy or a variant of an existing one, at least in any obvious way.
Poem machine ⁸	Copyright	Text can be analysed in a similar fashion by estimating word co-occurrence statistics from a corpus (the input data that determines the style) and producing new text with matching statistics. The methods can also take into account rhyme and other constraints. ⁹ In a related project, the partially random choices of the content was determined by using brain signals from users although the user had no conscious control of the outcome. ¹⁰
Flow Machines ¹¹	Copyright	The Flow Machines tool can extract patterns from a database music and create new compositions in the style of a chosen artist

⁶ T. Mitchell, *Machine Learning* (McGraw Hill, 1997).

⁷ <https://www.nextrembrandt.com>.

⁸ <https://runokone.cs.helsinki.fi/start>.

⁹ J. Toivanen, O. Gross, and H. Toivonen, ‘The Officer Is Taller Than You, Who Race Yourself!: Using Document Specific Word Associations in Poetry Generation’, in S. Colton, D. Ventura, N. Lavrac, and M. Cook (Editors), *Proceedings of the Fifth International Conference on Computational Creativity* (Jožef Stefan Institute, 2014).

¹⁰ A. Kantosalo, J. M. Toivanen, P. Xiao, and H. Toivonen. ‘From isolation to involvement: Adapting machine creativity software to support human-computer co-creation’, in S. Colton et al (2014), ft 9 above.

¹¹ <http://www.flow-machines.com/ai-makes-pop-music>

		of genre. Significant adjustment of (human) musicians is still needed to reach a satisfactory end result. This includes adding tracks, writing and producing lyrics, and mixing.
Invention machine	Patent	In principle, in order to optimize the design of, e.g., an antenna, two things are sufficient: a "goodness function" that assigns to each proposed design a value that is the higher the better the design, and an algorithm that explores possible designs to identify the ones that have high goodness values. Such an approach has been used successfully to find better antenna designs and electric circuits that have been awarded patents. ¹²
Robot Scientists Adam and Eve	Patent	Adam and Eve are systems capable of independently carrying out experiments in molecular biology, guided by an AI algorithm that generates hypotheses about reaction pathways and chooses experiments to test them. ¹³ Adam was claimed to be the first machine to independently discover scientific knowledge. ¹⁴

Overall, we argue that all the above examples are ‘autonomous’ only in a clearly constrained and limited scope and, as such, they can be probably handled within the existing law and regulation. The development of more advanced and more autonomous AI systems in the future may, however, challenge exiting notions in more fundamental ways.

3. AI and IPRs: Authorship and Inventorship

3.1. Copyright Law and Authors

Authors are always the starting-point and centre of any discussion on copyright law. According to the labour theory developed by Locke, for instance, the intellectual labour of the author mixed with other resources justifies the author’s right over the fruit of his/her labours. The personality theory by Hegel claims that a work belongs to or reflects the personality of his/her creator. Although the utilitarian theory starts with the welfare of the public and the society as a whole, the fact that the copyright is considered as an incentive for the authors to create cannot be denied. But who is to be conceived as the author of a work?

3.1.1 “Author” in European Copyright Law

¹² J. R. Koza, F. H. Bennett III, D. Andre, and M. A. Keane, ‘Genetic Programming: Biologically Inspired Computation that Creatively Solves Non-Trivial Problems’, in Landweber, Laura F. and Winfree, Erik (Editors), *Evolution as Computation, DIMACS Workshop* (Springer-Verlag, 2001).

¹³ R. D. King, K. E. Whelan, F. M Jones, P. G. K. Reiser, C. H. Bryant, S. H. Muggleton, D. B. Kell, and S. G. Oliver, ‘Functional genomic hypothesis generation and experimentation by a robot scientist’, *Nature*. 427(6971):247–252, 2004

¹⁴ <http://www.cam.ac.uk/research/news/robot-scientist-becomes-first-machine-to-discover-new-scientific-knowledge>

European copyright law comprises of the international copyright treaties of which the EU is a member, the EU legislation and the cases of Court of Justice of European Union (CJEU), as well as national laws and cases. In here we will only focus on the EU level.

The three major international treaties relevant to European copyright law are the Berne Convention¹⁵, the WIPO Copyright Treaty¹⁶ and the TRIPS agreement¹⁷. Although the term ‘author’ is often mentioned and used in the text of the Berne Convention, it is not explicitly defined.¹⁸ As Ricketson explains, the possible reason is that when the Berne Conventions was discussed, there was a similar understanding among the Member States on who is an author, thus further interpretation was not needed.¹⁹ Later, in the revision of the Convention, the divergences between national laws on other aspects of authorship have become more pronounced.²⁰ One of such divergences is the actual degree of intellectual creation required to meet the criteria of originality. Common law systems traditionally emphasize the degree of skill and labour involved, while continental law countries tend to put more weight on the level of creativity. Indeed, this issue may also indirectly concern questions of whether it is necessary for an author to be a natural or a judicial person.²¹ At the same time, however, the Berne Convention indirectly specifies one concept of author by stipulating that if the author’s name is indicated, he/she shall be regarded the author of a literary or artistic work in the absence of proof to the contrary.²² Rather than defining the author, though, this rule aims at offering some certainty and reducing the burden of proof for right holders. It seems reasonable to argue that the author could then be a natural or legal person, because both can exhibit their names on the work.

Both the WIPO Copyright treaty and the TRIPs agreement remain silent with regard to the definition of ‘author’, even though both treaties require compliance with the Berne Convention.²³

As the international treaties leave the discretion on the definition of ‘author’ to each national jurisdiction, the member states of the EU could have stipulated different concepts of the author in their respective copyright laws. As diversities in the definition of ‘author’ could have hindered the establishment of the internal market, the EU lawmakers have harmonized certain key concepts. Especially relevant are the Directives on cinematographic and audiovisual works, as well as the ones on computer programs and databases.

Article 2 (1) of the Computer Program Directive states that “the author of a computer program shall be the *natural person or group of natural persons* who has created the program or

¹⁵ Berne Convention for the Protection of Literary and Artistic Works as amended on September 28, 1979.

¹⁶ WIPO Copyright Treaty (WCT).

¹⁷ Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPs).

¹⁸ Jane C. Ginsburg, ‘The Concept of Authorship in Comparative Copyright Law’ (2003) 52 *DePaul. L.Rev.* 1063, 1069.

¹⁹ Sam Ricketson & Jane C. Ginsburg, *International Copyright and Neighbouring Rights: The Berne Convention and Beyond* (2nd eds, volume 1, OUP, 2005) 358.

²⁰ *Ibid.*, 359-60

²¹ *Ibid.*

²² Article 15.1 Berne Convention.

²³ Article 1, WCT; Article 2(2) TRIPs.

[...] the *legal person* designated as the right holder by that legislation”.²⁴ If literally interpreted, this clause seems to set up the general principle that the author shall be a natural person, that is, the human being, who has created the program.²⁵ On the other hand, the use of ‘right holders’ rather than ‘author’ makes it unclear whether a legal person could be regarded as ‘author’.

The legislative history tells us that this article follows the prevailing view in Continental Europe,²⁶ where it is understood that only natural persons can accomplish an intellectual creation and, therefore, be authors.²⁷ The integration of legal person try to respect the tradition of the Common law.²⁸ It is an exception to the basic concept.²⁹ Thus, it seems reasonable to say that a legal person cannot be the author, but rather the right owner.

The Database Directive follows this model in Article 4(1)³⁰. In addition, Article 2(2) of the Rental and Lending Directive³¹ and Article 1(5) of the Satellite Directive³² designate the principle director of a cinematographic or audiovisual work as the author. It is commonly accepted that the principle director is the natural person who takes the lead to make artistic decisions.

Indeed, some rules, such as those governing co-authorship (for instance in relation to other persons that contribute to the work, like screenwriters, cameramen, editors, and producers), might still interface with existing national concepts.³³ These types of leeway may leave some room for the member states to designate a legal person as ‘co-author’ of the cinematographic work or audiovisual work.

All in all, although the mentioned Directives offer some harmonized definition of ‘author’, there is not yet a uniform or common understanding of such concept in EU copyright law: on the one hand, the Directives define ‘author’ only for specific types of the works, and, on the other, there is still no clear answer as to whether a legal person can be regarded as an ‘author’.

3.1.2. Interpretation by the CJEU

Despite the fact that the CJEU never decided on the concept of author directly, such definition can be derived from a bunch of decisions on the merit of the criteria of ‘originality’.

²⁴ Article 2(1), Directive 2009/24/EC of the European Parliament and of the council of 23 April 2009 on the legal protection of computer programs[2009]OJ L111.

²⁵ Thomas Dreier, P. Bernt Hugenholtz (eds.), *Concise European Copyright Law* (2nd eds, Wolters Kluwer, 2016) 248.

²⁶ Michel Walter & Silke von Lewinski (eds.), *European Copyright Law: A Commentary* (OUP, 2010) 5.2.2.

²⁷ *Ibid.*

²⁸ Walter, n. 43, 5.2.6.

²⁹ *Ibid.*, 5.2.10.

³⁰ Article 4(1), Directive 96/9/EC of the European Parliament and of the council of 11 March 1996 on the legal protection of databases [1996] OJ L 77/20.

³¹ Article 2(2), Directive 2006/115/EC of the European Parliament and of the Council of 12 December 2006 on rental right and lending right and on certain rights related to copyright in the field of intellectual property [2006] OJ L 376.

³² Article 1(5), Directive 93/83/EEC of the European Parliament and of the council of 27 September 1993 on the coordination of certain rules concerning copyright and rights related to copyright applicable to satellite broadcasting and cable retransmission [1993]OJ L 248.

³³ Walter, n. 43, 6.2.8.

The requirement of originality in European copyright law is defined in the Computer Programmes Directive³⁴, the Database Directive³⁵ and Term Directive³⁶ as the “author’s own intellectual creation”. Up until the *Infopaq* decision of 2009³⁷, however, such interpretation of ‘originality’ applied only to specific categories of works, namely photographs, computer programs and databases. *Infopaq* extended the interpretation of originality as “author’s own intellectual creation” to all the other categories of work. Based on the argument that the Information Society Directive³⁸ should be rooted in similar principles as other Directives, the CJEU held that copyright protection within the meaning of Article 2(a) of InfoSoc Directive should apply only to a subject matter which is original in the sense that it is its author’s own intellectual creation.³⁹ The CJEU further interpreted this concept in other key decisions, such as *Murphy*⁴⁰, *Painer*⁴¹, and *Football Dataco*⁴², stating that ‘author’s own intellectual creation’ means that the author should “stamp his *personal touch* or reflect his *personality* in the sense that he *expresses his creative abilities* in original manner by making free and creative choices”.⁴³

Following this logic of extending the interpretation of the concept of originality from specific categories of work (as dictated in the law) to all categories of works (via case law interpretation), it seems reasonable to argue that the CJEU could extend the interpretation of ‘author’ as the natural or legal person from the specific categories of cinematographic and audiovisual works, computer programs and databases, to all categories of works. Indeed, this is a suitable interpretation in view of the establishment of a harmonized legal framework for copyright in the EU. It is then reasonable to predict that should the CJEU have to interpret the concept of ‘author’ it will extent the same interpretation already included in some of the EU Directives to all categories of works. Indeed, the emphasis on the ‘personal touch’ and ‘personality’ followed by the CJEU while interpreting the concept of ‘originality’ indicates an idea of author as a natural person (as only human beings may have personality and personal touch).

In sum, under current copyright laws and interpretations, a non-human or an entity with no legal personhood, like an AI, is not eligible for authorship status of cinematographic and audiovisual works, computer programmes and databases in the EU. Moreover, based on the line of reasoning

³⁴ Article 1(3), Directive 2009/24/EC of the European Parliament and of the council of 23 April 2009 on the legal protection of computer programs[2009]OJ L111.

³⁵ Article 3(1),Directive 96/9/EC of the European Parliament and of the council of 11 March 1996 on the legal protection of databases [1996] OJ L 77/20.

³⁶ Article 6(1), Directive 2006/116/EC of the European Parliament and of the council of 12 December 2006 on the term of protection of copyright and certain related rights [2006]OJ L 372.

³⁷ Case C-5/08 *Infopaq International A/S v Danske Dagblades Forening* [2009]ECLI:EU:C:2009:465.

³⁸ Directive 2001/29/EC of the European Parliament and of the Council of 22 May 2001 on the harmonisation of certain aspects of copyright and related rights in the information society [2001] OJ L 167.

³⁹ *Infopaq*, paras 36-37.

⁴⁰ Joined Case C-403/08 and C-429/08 *Football Association Premier League Ltd et al v. QC Leisure et al* [2011] ECLI:EU:C:2011:631.

⁴¹ Case C-145/10 *Eva-Maria Painer v. Standard Verlags GmbH et al.* [2013]ECLI:EU:C:2013:138.

⁴² Case C-604/10 *Football Detaco Ltd et al., v Yahoo! Etal* [2012]ECLI:EU:C:2012:115.

⁴³ Kan He, ‘The Concept of Originality in EU and China’ in Niklas Bruun et al (eds), *The Governance of IP in EU and China* (Edward Elgar,2016) 150.

followed by the CJEU in key cases concerning originality, it seems unlikely that an AI could qualify as the author of other types of the works either.

3.2. Patent Law and Inventor

European patent law operates in a complex multi-level system consisting of national and regional patent laws. The European Patent Convention (EPC)⁴⁴ has largely harmonized patent laws of the EU Member States at procedural and pre-grant stage, while leaving post-grant litigation activities related to infringement, as well as exceptions and limitations to infringements, to national jurisdictions.

Regarding defining ‘inventor’ the EPC states in Article 60(1) that “[t]he right to a European patent (...) belong[s] to the inventor or his successor in title”. According to Art. 60(3) EPC “[f]or the purposes of proceedings before the [EPO], the applicant shall be deemed to be entitled to exercise the right to the European patent”. However, the inventor is always entitled to be mentioned as such before the EPO, regardless of who files for the application.⁴⁵ The EPC and its Implementing Regulations clearly state that the application should mention the inventor (or its successor in title).⁴⁶ Finally, in the case where the inventor is an employee the EPC refers to national law provisions.⁴⁷

On the one hand, it is clear that if the patent does not mention an inventor it will not be accepted by the patent office on grounds that it is lacking formalities. On the other, however, neither the EPC nor its case law provide with any explicit definition of the nature (human or not) an inventor should belong to. Furthermore, in practice, the EPO never investigates whether the proposed inventor is indeed the ‘true inventor’.⁴⁸ This is probably justified by the fact that the European patent system is based on the so called “first to file” approach to patent entitlement, according to which priority of claims only depends on who is first to submit a complete application to the patent office.⁴⁹ This is opposed by the ‘first to invent’ approach followed in other countries (like the US before the American Invent Act) and that requires a procedure that allows to identify at what stage an intervention actually occurred.

Moreover, the national laws of most EU Member States do not include any specific definition of ‘inventor’.⁵⁰ This notwithstanding, though, under European patent law there is a presumption that inventions are made by natural persons only. For instance, even though in Europe, the right to the European patent may be transferred before the filing of the application (via human-centered types of acts such as contract, or inheritance or according to the applicable

⁴⁴ Convention on the Grant of European Patents of 5 October 1973 (European Patent Convention).

⁴⁵ EPC Art. 62

⁴⁶ EPC Art. 60.

⁴⁷ EPC Art. 60.

⁴⁸ EPC Implementing regulations, Rule 19 (2).

⁴⁹ Art. 60(2) EPC.

⁵⁰ “Inventorship of multinational inventorship” (2015) AIPPI. Available at:

http://aippi.org/library/?publication_title=inventorship+of+multinational+inventions&=&publication_categories%5B%5D=7&start_date_range=&end_date_range

national law on employee's rights)⁵¹, the inventor has the right to be mentioned as such before the EPO. Moreover, designating an inventor requires, among other things, stating "the family name, given names and full address of the inventor", which seems to conceive inventor as a human being. Another indication of such presupposition is that the law when referring to the inventor uses words like "right", "he" or "his"⁵².

Joint inventors or co-inventors exist when a patentable invention is the result of the inventive work of more than one inventor, even if they did not contribute in equal parts. Also in this case, however, it appears that only human beings (and only private persons) can qualify as 'co-inventors' under European law.

Indications that the EPC intended to refer to inventors as human beings can be found also in patentability requirements such as novelty, inventiveness and disclosure: these requirements are assessed based on the knowledge of a person skilled in the art (PSITA), which is "presumed to be a skilled practitioner" (i.e. a human being) "who is possessed of average knowledge and ability with normal means and a capacity for routine work and is aware of what was common general knowledge in the art at the relevant date".⁵³ The idea behind the creation of the imaginary figure of the PSITA is for the Office to make a fair judgment in comparison to the level of knowledge of the inventor at the time when the invention was made: should the inventor be a non-human, such comparison would become unbalanced.

3.2.1. Interpreting 'Inventor' - EPO and National Case Law

Currently, there is no EU or European-wide common forum for patent litigation. The most recent, yet still on-going, post-grant patent law harmonization effort in the European context is the EU Unitary Patent Package, that is an initiative for a new Unitary Patent (UP) (allowing getting patent protection in all EU countries by submitting a single request to the EPO) and a Unified Patent Court (UPC) within the EU (to offer users of the UP system a cost-effective option for patent enforcement and dispute settlement across Europe). As such, when it comes to interpreting European patent law, the cases passed down by the EPO Boards of Appeal, as well as the national court interpretations of the EU Member States are primary sources where to look for.

Broadly speaking, both the EPO and national courts have interpreted 'inventorship' as being determined by the 'contribution to the inventive concept'. 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.

The UK is amongst the only nation in Europe to somehow positively define 'inventor'. English law states that the inventor is the actual "deviser of the invention".⁵⁴ This provision has

⁵¹ Art. 60(1) EPC.

⁵² Art. 62 EPC.

⁵³ Guidelines for Examinations (2017), G.VII.3

⁵⁴ S.7 (3) PA 1997.

been interpreted by courts as: “whoever” has contributed to the inventive concept (understood as a whole) should be considered as an inventor. German law does not define ‘inventor’, but German case law has referred to ‘inventor’ as “the person” that have creatively contributed to the subject matter of the patent in view of the entire content of the patent application, including description and drawings (i.e. on the basis of the patent application as whole).⁵⁵ In French law there is no legislative or regulatory provision that explicitly defines inventor. Case law explains that the concept of ‘inventor’ is assessed with reference to the means which constitute the invention. According to Paul Matély “‘[w]hoever’ conceives and makes the invention has the status of inventor. The invention consists in means which constitutes the invention”.⁵⁶

Overall, it can be affirmed that thus far the concept of ‘inventor’ has not been given any particular focus in legislation nor case law in the EU area - the law remains silent in most cases (neither the EPC, nor the national laws of most EU Member states provide with an explicit definition of ‘inventor’) and the case law is quite scarce (no case law from the EPO Boards and little jurisprudential material stemming out from the national courts).

Generally, however, it can be derived from the wording of the relevant provisions and their interpretations that, even though patent ownership can be held also by legal persons, only human beings can qualify as ‘inventors’. Indeed, this way of reasoning is also reflected in a recent study conducted by the AIPPI organization, where several States were asked opinions about the need for developing a harmonized concept of ‘inventor’: all EU Member States interviewed favoured the creation of a common definition of ‘inventor’ as a ‘human being’.⁵⁷

4. A Theory of Evolution: Balancing Incentives and Access

The afore analysis shows that under current interpretations non-humans, such as AI systems, are not entitled to authorship nor inventorship status in Europe. At the same time, however, the law *per se* is partly silent as to whether non-humans can qualify for authorship/inventorship, this way leaving the issue possibly open to judicial interpretation.

As technological developments in AI bring new challenges to these traditional concepts, it raises the fundamental question of whether there is a need to shape the law and/or its interpretations in order to promote and not stifle technological developments. In other words, one could ask: is a system that either prevents copyright or patent protection on AI-generated innovations by prohibiting computer authorship or inventorship, or allows such IPRs only by permitting humans who have supported or discovered the work or invention of creative machines to be authors/inventors optimal? Addressing this crucial and fundamental question requires us to take a

⁵⁵ BGH decision X ZR 70/11 of 22 January 2013; BGH decision X ZR 53/08 of 17 May 2011 - *Atemgasdrucksteuerung*; BRG GRUR 1979 - 540 (541) - *Biedermeiermanschetten*; BRG GRUR 1978 - *Motorkettensäge*; BRG GRUR 1966 - *Spanplatten*.

⁵⁶ AIPPI, n. 67.

⁵⁷ *Ibid.*

step back and look at traditional theories that justify IPRs. We rely upon some major IP theories, namely the utilitarian or economic theories of intellectual property.⁵⁸

Utilitarian theories justify protecting IPRs for the purpose of creating an incentive for innovative and creative activities. By awarding an exclusive right to the creator of an artistic work or the inventor of a technical innovation, the government provides the right holder with *inter alia* the ability to hinder a competitor from utilizing such creation or invention. From an economic point of view, the right holder obtains a temporary ‘monopoly’ limited in scope and enforceable for specified period of time.

For patents, the justification is that, unless protection is provided, an inventor who is trying to cover the costs of R&D might face challenges when a new product is ready to be commercialized due to the ability of others to copy it. Because competitors are able to copy without having to bear R&D costs, the price of the product might drop and the inventor might not be able to cover the costs he/she has incurred. Ultimately, this might disincentivize developments of further inventions. Patents are also conceived positively in respect to secrecy, because they allow disclosure of information: the inventor discloses information about the invention in exchange of being granted a temporary limited monopoly. Disclosure allows competitors to *inter alia* target how to direct their R&D resources, i.e. how to ‘invent around’.⁵⁹

In the case of copyright, it is understood that creative activity usually include a ‘cost of expression’ (a firm cost, corresponding to the time used to create the work) and a ‘cost of production’ (a running cost, dependent on the number of copies produced). In order to be economically worthwhile to create a work of art, the estimated income from sales minus the cost of production should exceed or at least equal the cost of expression.⁶⁰ Even though several other factors can incentivize a creator, this economic argument is usually the most relevant one.

Indeed, a balance needs to be sought regarding protecting IP investments in order to promote innovations and creations, that is, between providing incentives and guaranteeing access.

How does all this, then, reflect on IPR regulation of AI with regard to authorship and inventorship? We answer this question by depicting three scenarios:

- 1) The Revolutionary school, with a ‘property-centered’ type of approach;
- 2) The Romantic school, with a ‘non property-centered’ approach; and
- 3) The Modernist school, with a ‘property-balanced’ approach.

This method will guide us towards developing a holistic map of key factors that are to be considered by legislators and policy-makers when trying to strike the balance between protection and access in the field of AI.

4.1. The Revolutionary School

⁵⁸ Peter S. Menell, *INTELLECTUAL PROPERTY: GENERAL THEORIES* (1999); Merges, Robert P., Menell, Peter S., Lemley, Mark A. and Jorde, Thomas M. (1997), *Intellectual Property in the New Technological Age*, New York, Aspen Publishers, Inc.

⁵⁹ William Landes and Richard Posner, *The Economic Structure of Intellectual Property Law*, Harvard University Press (2003), pp. 294-402.

⁶⁰ *Ibid*, pp. 37-165.

One possibility to regulate AI-generated innovations could be to include in the law (or jurisprudence) an explicit provision that allows non-human authorship/inventorship. This solution would follow a ‘property-centered’ type of approach in the sense that it would allow IPR entitlements to any innovation produced by non-humans, as far as the other protectability requirements are met.

From a ‘pure’ legal perspective, a provision of this kind would have the consequence of giving legal personhood to a non-human. In fact, both copyright and patent laws assume that the first author or inventor is also the first owner of the IPR. In other words, opening the door for AI to become authors/inventors, would make a non-human a right holder. Not only this is a much broader question than the one this paper aims at addressing, but it is also a question that, for the time being, should be answered in negative.

From the point of view of economic justifications of IPRs, increasing the reach of IP entitlements would indicate a policy focus on the need to provide incentives, rather than access. The question is then: who should we incentivise? Clearly, this mechanism does not aim at incentivising the machine, but some of the human stakeholders that are part of the innovation process. Generally, it could be argued that allocating IPRs this way and, thus, clarify that any AI-generated output can attract IPRs in favour of some human beings (upon meeting the other requirements) could either in-centivise or des-incentivise innovations in AI, depending on who these IPRs are allocated. For instance, should the IPRs be assigned automatically to the owner of the AI machine, it would incentivise him/her to produce more AI systems, but it could disincentivize other stakeholders in the innovation process, such as data set providers or the like. One option could be to include a rule for assignation of IP entitlements in favour of any natural person behind the arrangements necessary for the creation or the invention at stake. Even though this suggestion might be leaking from multiple practical angles, it appears to us that the major problem of this solution is the heavy reliance on IPRs and the unbalanced expansion of the scope of protection very much in favour of IP holders.

Indeed, strengthening the reach and/or scope of IPRs has often been conceived as a suitable policy measure at the beginning phases of technological innovation. Previous examples include the extension of patentable subject matters to allow protection for computer programmes and DNA/gene related inventions. At the same time, these same examples shed light on the negative side of regulating technology through law or regulation at a too early stage, with the US software industry being the most striking example: opening the doors to software and business methods patents have proven having disastrous consequences on legal certainty and the entire US patent system.⁶¹ Moreover, the European Parliament has already shown an eye of caution when it comes to AI and IPRs in particular, by explicitly demanding for a “horizontal and technological neutral approach to intellectual property” with regard to AI, as well as a “balanced approach to IPR [...]

⁶¹ Ballardini, R.M, *Intellectual Property Protection of Computer Programs. Developments, Challenges, and Pressures for Change*, Economics and Society – 246 (2012), <https://helda.helsinki.fi/handle/10138/35504>.

that protect and at the same time foster innovation”.⁶² Also mainstream scholarly literature has lately claimed that “the main risk to advanced economies may not be that the pace of innovation is too slow, but that institutions have become too rigid to accommodate truly revolutionary changes”.⁶³

In the light of all this, creating new rules for AI and authorship/inventorship might not be justified neither from a purely legal point of view, nor from an economic perspective, as it might ultimately hinder rather than promote technological development.

4.2. The Romantic School

On the other extreme, a solution could be sought in a ‘property-last’ type of approach where no IPRs entitlements would be conceived for creations or innovations made by non-humans.

From a legal point of view, the Romantic school follows the idea that the existing IPR framework should be interpreted so to allow only natural persons to be authors/inventors in all categories. In addition, this approach would categorically deny IPR entitlement on non-human produced innovations.

From the point of view of economic theories of IPR, it could be argued that securing IP protection on the AI systems is sufficient to recoup the R&D costs and investments and, thus, to incentivise new developments, while extending IPR also to the results produced by an automated system is not justified. As such, allowing innovations created by AI to fall into the public domain might ultimately benefit society more than assigning exclusive rights only to some.

This School, however, does consider several important factors, *inter alia* the fact that developers, might actually build AI systems exactly for the purpose of creating artistic works or technical inventions in certain specific ways that, for instance, would not be possible to be done by human beings themselves. Indeed, in these cases, what incentivise humans to develop AI systems is the prospect of having exclusive rights on the output. This could be even more true in cases where for e.g. the AI machine *per se* would not be able to attract IPRs (because for e.g. the IPR requirements are not formally met), but the outcome could.

These situations might lead to an increase in the use of trade secrecy or contractual agreements as legal tools to protect AI-generated innovations. As previously mentioned, IPRs are usually conceived as better tools to promote innovation than secrecy. In addition, this system might ultimately create an additional burden on patent or copyright offices, or ultimately courts, as to how to find out whether a work or an invention has been created by a human or not.

In the worse scenario, a Romantic school way of thinking might discourage rather than foster investments and developments in AI as a whole.

⁶² Report with recommendations to the Commission on Civil Law Rules on Robotics (2015/2103(INL)), 27.01.2017: <http://www.europarl.europa.eu/sides/getDoc.do?pubRef=-//EP//TEXT+REPORT+A8-2017-0005+0+DOC+XML+V0//EN>, Retrieved on 12.2.2018.

⁶³ The Economist, *Innovation pessimism: Has the ideas machine broken down?*, 22 (12 January 2013)

4.3. The Modernist School

Finally, a way to approach the issue could be to include in the law (or jurisprudence) a provision stating that only ‘natural’ persons can be authors/inventors and, at the same time, create a rule according to which the natural person(s) behind the arrangements necessary for the creation or the invention at stake should be considered as the author/inventor. The Modernist school follows a similar approach that have been embraced in the UK with regard to computer-generated works, according to which: “[I]n the case of a literary, dramatic, musical or artistic work which is computer-generated, the author shall be taken to be the *person* by whom the arrangements necessary for the creation of the work are undertaken”⁶⁴.

Indeed, a provision of this kind would leave no doubt that non-humans cannot be authors/inventors and that creations or inventions produced by non-humans cannot attract IPRs. Yet, it would not remove possible problems and controversies for entitlement of IPRs. In fact, in the AI context, several could be the possibilities for IPR entitlement, including *inter alia* assigning IPRs to: i) the designer(s) of the system, ii) the data provider(s), and iii) the user(s) of the system. On the other hand, though, a rule of this kind should be interpreted in view of the actual contribution of the humans to the work or invention: in order to get status of author/inventor one would need to have contributed to the work or invention via putting his/her own intellectual creation or via sufficiently contributing to the inventive concept.

From the point of view of economic theories one could ask whether there is a reason for granting IPRs to a natural person that is behind the innovation created, even in the case where the AI-generated innovations were not originally foreseen by the human. On the one hand, even though the complexity of developing AI systems requires considerable upfront investments on R&D, such IPRs should be directed to the AI machine *per se*, rather than the innovations generated by such AI. On the other, it is certainly undeniable that, currently, without human intervention no AI system could exist. But does this justify the extension of IPRs also to the AI-generated results?

We have already seen in the Romantic school what the potential negative effects of a system that forbids IPRs on non-human generated innovations could be. In addition, an evident way to justify the Modernist school is the fact that IPRs would arise only in cases where a sufficient human contribution to the AI-generated innovation is found. In other words, unless the human contribution in the development of the AI-generated output suffice the purpose of showing the existence of a humans’ own intellectual creation or contribution to the inventive concept, no (human) author/inventor would be found. Indeed, it is likely that these questions would ultimately be addressed while assessing the originality of inventiveness of the innovations at stake. To date, though, it is quite evident that the creation of increasingly advanced AI systems will require immense efforts by humans even in the future because the problems get harder and harder. As such, it appears that the role of humans in the innovation process will remain crucial not only in the development of AI systems *per se*, but also of the AI-generated output.

⁶⁴ Copyright, Designs and Patents Act 1988, section 9(3).

5. Conclusion

Traditionally, technological changes have generated tensions in the intellectual property system. AI technology is not an exception. With increasingly advanced AI, the roles of author/inventor are likely to become less clearly defined. This will challenge the established notions of authorship and inventorship in copyright and patent laws. The Revolutionary and the Romantic schools do not seem justifiable neither from the perspective of legal traditions nor from the point of view of the economic justification of IPRs. As one extreme, the Revolutionary school assigns legal personhood to AI, fundamentally contradicting our general understanding of law. Moreover, even where the AI is an author/inventor, the need to incentivize human participants in the innovative process remain: such a determination might be highly complex and too challenging at this stage. The Romantic school categorically excludes possibilities to attract IPRs to non-human generated innovations. This solution, however, neglects to provide proportionate incentives to the humans participating in developing the AI systems and, potentially, the AI-generated output. The Modernist school, as a compromise, allows IPRs entitlements to the natural persons that have sufficiently contributed to the AI-generated output. As such, it may be a better fit to promote innovation in a world of AI-generated content. On one hand, it does not distort the commonly accepted legal principles, while, on the other, it offers a reasonable and proportionate incentive to the human parting in the innovation process that ultimately lead to the AI-generated output.