

Patentability of AI-Generated Inventions

-Is a Reform of the Patent System Needed? (*)

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As technology advances, artificial intelligence (AI)-generated inventions – i.e., inventions created autonomously or semi-autonomously by computer systems – are deemed to becoming more common. The human ingenuity in such inventions is less visible, while at the same time the inventing activity becomes easier, as most of the mental effort is passed on to the AI. However, this scenario makes it harder to assess whether the invention possesses an “inventive step” – a condition for patentability that requires the invention to be non-obvious to a skilled person (or not-easily invented by a skilled person). Indeed, a given AI-generated invention might be non-obvious to a skilled person; but it will probably be obvious to a person that has access to a similar AI. The main aim of this research is to assess whether patent laws are fit for purpose with regard to the patentability of AI-generated inventions, in particular in what concerns the inventive step requirement. With that objective, the research carries out a comparative analysis of the inventive step (or non-obviousness) requirement in Japan, the European Union and the United States. The research will conclude with recommendations towards an international harmonization of the interpretation of, and practices related to, the inventive step requirement in the field of AI-generated inventions.

I. Introduction

Where an AI is involved, odds are that inventing becomes quicker, unburdened with human bias and possibly cheaper. The easiness of inventing brought by AI may lead to an increase of patenting activity, which might in turn lead to low quality patents, patent flooding and patent trolling.

In this scenario, patent policies might need to be recalibrated. Out of the requirements for patentability, the inventive step or non-obviousness is the most difficult to assess, both in theory and in practice.¹ But the requirement is central to defining an invention, and it is of utmost importance in instances where society and technology are rapidly changing.² When it comes to AI-generated inventions, it is thus in the requirement for patentability of inventive step or non-obviousness that most problems lie. While an invention might be non-obvious to a skilled person, that same invention might become obvious when seen through the lenses of a skilled person

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¹ O. GRANSTRAND, “Patents and policies for innovations and entrepreneurship”, in T. Takenaka, *Patent Law and Theory. A Handbook of Contemporary Research*, Cheltenham, Edward Elgar, 2009, p. 89.

² J. DUFFY, “Inventing invention: A case study of legal innovation”, *Texas Law Review* 2007, 86(1), p.2.

who can use a similar AI system to generate it.

The main aim of this research is to pave the way for the harmonization of the inventive step requirement in relation to AI-generated inventions, in the US, Europe and Japan. By studying and proposing recommendations targeted towards efficient and balanced examination practices of AI-generated inventions, this research also aims to contribute to making the patent system fit for purpose when an AI is involved in the inventing process. The research report first defines the concept of AI systems, and explains the role that AI plays in inventing processes (Section II). Next, the rationales or justifications underlying the patent system are analyzed, so as to provide a solid framework against which the assessment of the inventive step or non-obviousness in relation to AI can be performed (Section III). Section IV of the report follows to examine the concept of invention and the inventive step/non-obviousness patentability requirement in the three jurisdictions concerned (United States, Europe and Japan). Section V then briefly assesses the results of the previous Section in a comparative fashion, and Section VI provides a few conclusions and recommendations.

II. Artificial intelligence systems as inventors

This report combines a technical definition of AI with a teleological one. In the present context, AI will thus amount to a technology that (1) is able to understand unstructured data (as opposed to pre-AI machines, which only processed structured data and which dealt with data whose meaning was defined in advance); (2) is able of computer reasoning (i.e., reaching conclusions and understanding the rationales underlying such conclusions); (3) is able to learn automatically; and (4) can be used to automatize (even if partially) the inventing process. The inventing process implies identifying a problem to be solved, creating a solution to solve the problem, and applying the technical teachings of that solution to the problem. AIs are not inventors as such, since they do not define the problem to be solved, nor the technical teachings. But AIs are nothing like other tools that were traditionally used to invent, either. They enhance human inventing capabilities and skills in a way that had not been seen before. They autonomously provide, test and select technical solutions, and can act beyond pre-defined tasks.³ Thus, current AIs stand somewhere between the traditional tools used by humans to invent, and a completely autonomous being that is able to autonomously carry out the inventing process from beginning till end.

³ P. BLOK, “The inventor’s new tool: Artificial Intelligence – how does it fit the European patent system?”, *European Intellectual Property Review* 2017, 39(2), at 70.

III. Rationales of the patent system

The main justification for the patent system is the incentive theory, which sees patents as an incentive to innovate, for the benefit of society.⁴ According to this theory, absent a patent, the inventor would be discouraged from engaging in inventive activities, as she would not be able to prevent free-riders.

Another theory that justifies the grant of patents is the natural rights theory, according to which an individual should have natural property rights over the products of her mind.⁵ However, granting property rights over the result of one's labor should be conditioned to the fact that "there should be enough and as good left for in common for others".⁶

The specific rationale for introducing inventive step or non-obviousness as a patentability requirement should also be considered. The inventive step/non-obviousness precludes exclusive rights being granted over trivial advances, as a way to prevent the number of patents from rising to undesirable levels and potentially hindering those skilled in the art due to the ensuing patent thicket.⁷

Underlying the grant of a patent is also the disclosure of technical information that, absent patent protection, the inventor would choose to keep secret in order to maintain a competitive advantage. This is related to another theory justifying the existence of patents, which we can call the social contract or informational theory.⁸

Alongside with these theories, the personality theory is also used to justify intellectual property rights. This theory views creations as an extension of the creator's personality, and property over such creations as a mechanism for self-development and personal expression.⁹ The personality rights theory has been used in relation to copyright,¹⁰ but less so in the patent arena. However, it has also been argued that these views are based on a narrow construction of the concept of personality, since the inventor's intellectual skills, vision or imagination also play a role

⁴ E. DERCLAYE, "Patent law's role in the protection of the environment – re-assessing patent law and its justifications in the 21st century", *International Review of Intellectual Property and Competition Law* 2009, 40(3), pp. 253-255; M. FISHER, "Classical economics and philosophy of the patent system", *Intellectual Property Quarterly* 2005, 1, pp. 12-13.

⁵ M. FISHER, *op. cit.*, p. 6.

⁶ J. LOCKE, *Two Treatises of Government* (ed. P. Laslett), Cambridge, Cambridge University Press, 1988, p. 288. See also, on this condition, G.B. RAMELLO, "Private Appropriability and Sharing of Knowledge : Convergence or Contradiction ? The Opposite Tragedy of the Creative Commons", in L. Takeyama, W.J. Gordon & R. Towse (eds.), *Developments in the Economics of Copyright. Research and Analysis*, Cheltenham, Edward Elgar, 2005, pp. 134-135.

⁷ U. STORZ, "Patentability requirements of biotech patents", in U. Storz et al. (eds.), *Biopatent Law: European vs. US Patent Law*, Heidelberg, Springer, 2014, p. 55.

⁸ F.K. BEIER & J. STRAUS, "The patent system and its informational function – yesterday and today", *International Review of Intellectual Property and Competition Law* 1977, 8(5), pp. 389-391.

⁹ J. HUGHES, "The philosophy of intellectual property", *Georgetown Law Journal* 1988, 77, p. 330.

¹⁰ *Ibid.*

in the inventive process.¹¹ Therefore, while the personality theory is not central to discussions on patent rationales, it can nevertheless be an ancillary basis for justifying patent rights.

All these theories relate to *ex ante* justifications for patents – i.e., to reasons as to why patents should be in place. Other, more recent, theories have focused on *ex post* justifications for intellectual property, including patents. Such theories justify intellectual property rights based on the incentive they give to right owners for managing subject matter that has already been created (regarding e.g. improvement and commercialization of the underlying product).¹²

Independently of the theory at stake, these justifications of the patent system bear difficulties in terms of patent regulatory policy. Patent rationales should be reflected in concrete patentability requirements and patent scope, while always bearing in mind a necessary balance: too lax patentability requirements and broad patent scope may lead to patent flooding, but too strict patentability requirements and narrow patent scope may halt innovation and inventive activities.

IV. Comparative study of the inventive step requirement

1. US

Section 103 of the US Patent Act states that a patent cannot be obtained “if the differences between the claimed invention and the prior art are such that the claimed invention as a whole would have been obvious before the effective filing date of the claimed invention to a person having ordinary skill in the art to which the claimed invention pertains. Patentability shall not be negated by the manner in which the invention was made.” “The art to which the claimed invention pertains” comprises analogous arts, i.e., arts from the same field independently of the problem addressed, and arts from a different field but that solve the same problem or have the same purpose.¹³ Non-analogous art, on the other hand, cannot be used when judging whether the invention is obvious or non-obvious.¹⁴ The level of ordinary skill in the pertinent art is defined taking into account several factors, which were defined the Federal Circuit in case *Environmental Designs, Ltd. v. Union Oil Co.*, among which the rapidity with which innovations are made or the

¹¹ O. TUR-SINAI, “Beyond incentives: expanding the theoretical framework for patent law analysis”, 2010, available at https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1697254 (last accessed 11 January 2018), p.27 et seq.

¹² M.A. LEMLEY, “Ex ante versus ex post justifications for intellectual property”, *University of Chicago Law Review* 2004, 71, p. 129-130.

¹³ J. SHERKOW, “Negating invention”, *Brigham Young University Law Review* 2011, pp. 1109-1110. The author gives as an example of arts from the same field but that solve different problems toothbrushes and hairbrushes; and provides the case of cone-shaped caps for oil decanters and cone-shaped caps for bags of popcorn as an example of arts that exist in different fields of endeavor but solve the same problem or have the same purpose.

¹⁴ *Ibid.*

sophistication of the technology.¹⁵ The USPTO, following a US Supreme Court case,¹⁶ will assess whether an invention is non-obvious following a step-by-step inquiry determining: the scope and content of the prior art; differences between the prior art and the claimed invention; the level of ordinary skill in the pertinent art; and secondary considerations that can provide objective evidence of non-obviousness, such as “commercial success, long felt but unsolved needs, [and] failure of others,” that “may have relevancy” as “indicia of obviousness or non-obviousness.”¹⁷

The last sentence of Section 103 (stating that a patent cannot be negated due to the way the invention was made), highlights that it is the outcome of the inventive process that is evaluated in the framework of the non-obviousness analysis. US Courts have extensively confirmed this.¹⁸ The argument could then be made that inventions developed by an AI by chance (or as a result of a semi-automated process where multiple trial-and-error experiments are conducted, for example) cannot be negated by the manner in which they were made. However, some court decisions have lent some flexibility to the prohibition to negate the patent due to the way in which the invention was made. For instance, in *Mayo Collaborative Services v. Prometheus Laboratories, Inc.*,¹⁹ the US Supreme Court gave as one of the reasons to invalidate a patent the fact that the claimed invention involved “well-understood, routine, conventional activity, previously engaged in by researchers in the field.”- i.e., the Court focused on *how* the invention had been implemented, despite the prohibition of Section 103.²⁰ It is also possible to argue that the last sentence of Section 103 was intended by the US legislator to level the different inventive processes that can be undertaken by humans – not machines.²¹

2. Europe

Article 56 of the European Patent Convention defines the inventive step requirement as follows: “An invention shall be considered as involving an inventive step if, having regard to the state of the art, it is not obvious to a person skilled in the art [...]”. In Europe, the person skilled in the art is “presumed to be a skilled practitioner in the relevant field of technology, who is possessed of average knowledge and ability and is aware of what was common general knowledge in the art

¹⁵ *Environmental Designs, Ltd. v. Union Oil Co.*, 713 F.2d 693 (1983).

¹⁶ *Graham vs. John Deere*, 383 U.S. 1 (1966).

¹⁷ *Graham v. Deere* 17-18.

¹⁸ See case law cited in D.S. CHISUM, *op. cit.*, Sec. 5.04A[2].

¹⁹ 566 U.S. 66 (2012), Docket no. 10-1150.

²⁰ J.SHERKOW, “And how: *Mayo v. Prometheus* and the method of invention”, *Yale Law Journal Forum* 2012-2013, 122, 351-352.

²¹ B. HATTENBACH & J. GLUCOFT, “Patents in an era of infinite monkeys and artificial intelligence”, *Stanford Technology Law Review* 2015, 19, 44.

at the relevant date.”²² The relevant field of technology can encompass neighboring fields or a broader general technical field (if the same or similar problems arose therein, and if the person skilled in the art ought to be aware of them).²³ The person skilled in the art is also presumed to have had at her disposal “the means and capacity for routine work and experimentation which are normal for the field of technology in question,”²⁴ but she lacks creative thinking and inventive imagination.²⁵

In assessing the inventive step, the EPO follows the so-called problem-solution approach consisting of three steps: (1) determining the closest prior art; (2) establishing the objective technical problem to be solved; (3) considering whether the claimed invention, starting from the closest prior art and the objective technical problem, would have been obvious to the skilled person.²⁶ In addition to these steps, secondary indicia may be taken into account, such as the satisfaction of a long-felt need,²⁷ or the commercial success derived from the technical features of the invention.²⁸

3. Japan

Article 29(2) of the Japanese Patent Act prescribes that a patent shall not be granted where, prior to the filing of the patent application, a person ordinarily skilled in the art would have been able to easily make the invention. In principle, the relevant art will include the so-called “adjacent art”, as the Examination Guidelines of the JPO states that all technical matters in the field relevant to the problem should be considered.²⁹ Similarly to other jurisdictions, the assessment is made from the perspective of “a person ordinarily skilled in the art”, who, among other characteristics, is able to use ordinary technical means for research and development and is able to exercise ordinary creativity in selecting materials and changing designs.³⁰

Examiners will follow a step-by-step methodology to assess the existence of inventive step, according to which they will (1) identify the claimed invention; (2) identify one or more prior art relevant to the claimed invention; (3) select the closest prior art, compare that prior art and the claimed invention, and find similarities and differences; (4) evaluate the differences: determine the

²² EPO Guidelines, Part G – Chapter VII -1.

²³ Case *Pencil Sharpener* (T-176/84), Boards of Appeal of the EPO.

²⁴ EPO Guidelines, Part G – Chapter VII -1.

²⁵ D. VISSER, *The annotated European Patent Convention [2000]*, 25th ed., Kluwer Law International, 2017, commentary on Article 56.

²⁶ EPO Guidelines, Part G – Chapter VII-3.

²⁷ Case *Blount* (T699/91), Boards of Appeal of the EPO.

²⁸ Case *Pyrazolopyrimidinones for the treatment of impotence/ Pfizer Limited et al* (T1212/01), Boards of Appeal of the EPO.

²⁹ WIPO, “Study on inventive step”, 2015, available at http://www.wipo.int/edocs/mdocs/scp/en/scp_22/scp_22_3.pdf (last accessed 9 February 2018), p. 7.

³⁰ Examination Guidelines for Patent and Utility Model in Japan, Part III, Chapter 2, Section 2.3.

reasons for denying inventive step, based on the content of the selected prior art or other relevant prior art, and the common general knowledge.³¹ Apart from the described methodology, other considerations can also be taken into account when assessing the inventive step requirement. Indicators of the existence of inventive step include situations of commercial success and long-felt need.³²

A few decisions of the Intellectual Property High Court have placed emphasis on the *effort* put in by the inventor in coming up with the invention: the Court has specifically linked “significant effort”³³ in conceiving the invention with a finding that such invention could not have been easily made by the person skilled in the art. This might indicate that a special or high level of effort is a factor to be taken into account when assessing the inventive step requirement in Japan, which is relevant in case the inventing effort needed to satisfy the inventive step requirement mainly originates from an AI and not from the patent applicant.

V. Assessment

The objective of the criteria relating to inventive step or non-obviousness is the same in the three jurisdictions: to exclude from patentability inventions that could be easily made by a person skilled in the art, since doing so could hamper the development of technology.³⁴ It can also be argued that the laws in the three jurisdictions are similar. The notion of “easily conceived” is inherent to the Japanese test, but not to the European or US tests, even though it is considered that the Japanese test is akin to obviousness as understood in the US.³⁵ The difference between “inventive step” and “non-obviousness” is not necessarily negligible (as the former relates to the relation between the invention and prior art, while the latter refers to the mental process of the person skilled in the art),³⁶ but again the underlying goal of the provision approximates the laws in spirit if not in drafting.

The approach taken by the three Offices is similar in the sense that they all compare the invention with prior art and assess the differences between them. Moreover, the three Offices limit the scope of prior art by relating it to the specific field of the claimed invention, but all three

³¹ WIPO, *op. cit.*, p. 14.; Examination Guidelines for Patent and Utility Model in Japan, Part III, Chapter 2, Sections 2.3. and Section 3.

³² Examination Guidelines for Patent and Utility Model in Japan, Part III, Chapter 2, Section 2.3., and N. NAKAYAMA, *Patent Law*, 2nd ed., Tokyo, Koubundou Publishers, 2012, p. 137.

³³ See e.g. case 2016 (Gyo-Ke) 10186, 21 March 2017 and case 2012 (Gyo-Ke) 10111, 28 January 2013.

³⁴ G. DINWOODIE ET AL., *International and Comparative Patent Law*, Newark, LexisNexis, 2002, p. 141.

³⁵ K. KAGEYAMA, “Determining inventive step or nonobviousness for a patent requirement in view of the formation process of an invention,” *Beijing Law Review* 2016, 7, pp. 241-242.

³⁶ O. GRANSTRAND, “Are we on our way in the new economy with optimal inventive steps?”, in O. Granstrand (ed.), *Economics, Law and Intellectual Property. Seeking Strategies for Research and Teaching in a Developing Field*, Dordrecht, Springer, 2003, p.237.

include adjacent, analogous or neighboring fields in the scope of prior art. Common to the three procedures is also the fact that it is possible to use secondary considerations – such as commercial success – in the assessment of inventive step/non-obviousness.

The assessment of inventive step/non-obviousness is made from the perspective of the person skilled in the art in all three jurisdictions. However, in Japan and the US the threshold for patentability might be higher because it is considered that the person skilled in the art has an ordinary level of creativity. Conversely, in Europe, the person skilled in the art will not engage in scientific research in areas not yet explored, which could be read as meaning that the person skilled in the art will not use AI in a field where AI is not widely used.

Even though the laws are similar and the approach taken by the three offices is similar in some aspects, the remaining differences in guidelines and procedures for examination might lead to divergent solutions on this subject, not least because the inventive step/non-obviousness test is highly subjective. A specific solution should be sought for the examination of AI-generated inventions in relation to their compliance with the inventive step. The next section will deal with this issue.

VI. Conclusions and Recommendations

It can be questioned whether the justifications to grant patents are still present in cases where human intervention and efforts are minimal. In all current constructions of AI-generated inventions a human is still, to a greater or lesser extent, involved. This means that the reasons to grant patents still exist in relation to AI-generated inventions, albeit they might be constrained to a small contribution by a human being. Because the justifications for granting patents might be diminished (although not extinguished) in cases where an AI-generated invention is involved, patent policies should also be revisited.

The crux of the matter in terms of patentability is the inventive step or non-obviousness requirement, which, while being the most difficult to assess, is also central to defining an invention. Ideally, then, the inventive step or non-obviousness requirement should be rethought in light of technological development. The main problem with this approach is that, regardless of the jurisdiction, the tendency seems to be to assess the achievement of the invention (i.e., whether it is non-obvious) and to disregard the (necessarily subjective) achievement of the inventor and the history behind the invention/the inventing process.³⁷ Moreover, while the laws are similar in the three jurisdictions analyzed, some differences show at the procedural level, i.e., regarding Office

³⁷ Putting forth a similar observation regarding the European system, C. SEVILLE, *EU Intellectual Property Law and Policy*, 2nd ed., Cheltenham, Edward Elgar, 2016, p. 147.

guidelines and examination processes.

The analysis carried out in this report reveals that amending laws would not be a viable solution, as they would run the risk of becoming outdated in the future. In addition, changing laws is burdensome due to the political processes involved, and does not therefore amount to a realistic solution. A better course of action is to develop common guidelines on this subject between the Patent Offices. In that regard, several measures can be adopted.

Clear common guidelines on the **notion of analogous, neighboring or adjacent art** should be adopted. Since non-analogous art cannot be used when judging whether the invention is obvious or non-obvious, the scope of “analogous/neighboring/adjacent art” should be broadened in Examination Guidelines, as a way to counteract the effects of a potential “race to patent” derived from the easiness to invent in the context of AI (as the broader the pertinent art, the more likely it is to find prior art that makes the invention obvious/lacking inventive step).

Technological development in general and the use of AI specifically should also be taken into account when assessing **who the person skilled in the art is**. AI might affect the level of skill of the person skilled in the art and her level of creativity.³⁸ It would be advisable that the European practice becomes aligned with the Japanese and US ones, in the sense of considering that the person skilled in the art has ordinary creativity. Moreover, it should specifically be considered what means the skilled person has at her disposal. Both the EPO and JPO Guidelines mention that the skilled person has ordinary or normal technical means for experimentation/research and development. The USPTO Guidelines do not contain such a reference, but mention the sophistication of technology and the rapidity with which inventions are made as a factor when determining the level of ordinary skill in the pertinent art. It would thus be possible to build on these existing practices and consider the use of AI in the inventing process in the following fashion: if the use of AI is not a normal means of experimentation in the relevant art, a patent can be granted if the invention is not obvious for a person skilled in the art without the use of AI (even if AI was used by the inventor in question). Conversely, if the use of AI is a normal means of experimentation in the relevant art, the skills of the person skilled in the art improve and AI use is taken into account – which means that a patent can be granted if the invention is not obvious for a person skilled in the art who uses the AI (even if AI was not used by the inventor in question). The determination of the extent of AI use could be done by reference to inventing practices in general in a given field, which could be achieved through studying and researching industry trends.

Furthermore, all the three jurisdictions take **secondary indicia** into consideration. Many of those secondary indicia – such as commercial success – are the same, and are part of their

³⁸ B.M.SIMON, “The implications of technological advancement for obviousness”, *Michigan Telecommunications and Technology Law Review* 2013, 19, p. 347.

respective Examination Guidelines. It would therefore be advisable to consider adding a “made by AI” factor as an indication of obviousness. The fact that these indicia are not central to the examination, and that they must be balanced with other factors, means that the fact that an invention is AI-generated is not a deal-breaker in terms of inventive step/non-obviousness compliance (therefore not chilling AI use and technological development).

The solutions proposed imply increasing the threshold for a finding of inventive step/non-obviousness, i.e., increasing the patentability threshold, and make the grant of a patent justifiable in light of patent rationales. The financial and reputational incentives given to inventors – or better said, to participants in the inventing process – are still in place, but for inventions which would not be created absent the patent system. The intellectual labor of the human being participating in the inventing process (e.g., in setting the problem to be solved, or in applying the technical teachings) is rewarded, while some is left for others to invent due to the increased patentability threshold. The vision of the human being who participates in the inventing process is also still protected under the personality theory. In case a patent is granted in a given AI-generated innovation, information is still exchanged in the form of disclosure/enablement. And – last but not least – the patent granted on an AI-generated innovation will transform the latter into a transferrable asset, as per ex post theories justifying the patent system.