Artificial Intelligence and the re-imagination of inventive step

by **Maurice Schellekens***

Abstract: Artificial intelligence alleviates the work of the inventor. It may even in a distant future take the place of the human inventor. Legal literature has amply reflected about the implications of AI for the requirement of inventive step. In the literature, much attention has been paid to the algorithms of AI since the role they play seems to be the most similar to that of the human inventor. Although it cannot be completely ruled out that the human inventor will eventually be displaced, it seems to be something for a distant future. This article analyses the implications for the inventive step requirement and concludes that the introduction of a machine-skilled in-the-art as a criterion figure creates many new problems and that in the foreseeable future, existing criteria may function better than is sometimes suggested.

Keywords: patent law; inventive step; artificial intelligence; person-skilled-in-the-art; machine-skilled-in-the-art

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A. Introduction

1 Artificial Intelligence is claiming an increasing role in inventive process. AI promises to find new technical solutions that engineers working from the way they were trained would not so easily arrive at. Inventions made with the help of AI will have little problem meeting the present inventive step requirement, while at the same time the inventive process will be facilitated by the automation that AI brings. At some point, patent law must address the question how to assess inventive step in the context of AI. Unlike other literature that sees especially the algorithms as disruptors, this article emphasizes the role of datasets and how data cause problems for the application of the inventive-step-requirement.[1] This article distinguishes different approaches and asks what their merits and shortcomings are. This article focuses on the inventive step requirement under the European Patent Convention. Other questions relating to the patentability and AI are not addressed.[2]

* Dr. Maurice Schellekens is a senior lecturer at the Tilburg Institute for Law, Technology, and Society, Tilburg University.

1 Ryan Benjamin Abbott, 'Everything is Obvious' (2018) 66 UCLA L. Rev. 2, 42-44 <https://ssrn.com/abstract=3056915> or <http://dx.doi.org/10.2139/ssrn.3056915> accessed 6 December 2021.

2 Literature that addresses other questions comprises: Oliver Baldus, 'A practical guide on how to patent artificial intelligence (AI) inventions and computer programs within the German and European patent system: much ado about little' (2019) 41 E.I.P.R. (12), 750-754, Robin C. Feldman and Nick Thieme, 'Competition at the Dawn of Artificial Intelligence' in Björn Lundqvist and Michael S. Gal (eds), Competition Law for the Digital Economy, Edward Elgar Publishing at 71, UC Hastings Research Paper No. 298 https://ssrn.com/abstract=3218559 accessed 6 December 2021, Celine Castets-Renard, 'The intersection between AI and IP: conflict or complementarity?' (2020) 51 IIC (2), 141-143, W. Michael Schuster, 'Artificial Intelligence and Patent Ownership' (2018) 75 Wash. & Lee L. Rev. 1945 <https://scholarlycommons.law.wlu.edu/wlulr/vol75/iss4/5>, Erica Fraser, 'Computers as Inventors – Legal and Policy Implications of Artificial Intelligence on Patent Law' (2016) 13 SCRIPTed (3) 305 <https://script-ed.org/?p=3195. or DOI: <10.2966/scrip.130316.305>, Heinz Goddar and Lakshmi Kumaran,

B. Preliminaria

2 Artificial Intelligence can be defined as:[3]

> Artificial intelligence (hereinafter AI) refers to systems designed by humans that, given a complex goal, act in the physical or digital world by perceiving their environment, interpreting the collected structured or unstructured data, reasoning on the knowledge derived from this data and deciding the best action(s) to take (according to pre-defined parameters) to achieve the given goal. AI systems can also be designed to learn to adapt their behaviour by analysing how the environment is affected by their previous actions.

3 A special type of AI - machine learning – allows AI to address problems that cannot fully be defined formally or where the reasoning cannot fully described using fully specified formal reasoning rules. Machine learning, along with increased processing and storage capacity of computers, has caused a revival of interest in and applications of AI, such as in Research & Development. Machine learning has a number properties that make it suitable for use in inventive processes.[4] AI may be used to discover relations between data that are not readily apparent. It is able to process large amounts of data that may be hard to process using other techniques. It may itself bring structure in data without the need for a human programmer or data-analyst to create the structure beforehand. This is not just theory, AI has already given rise to inventions. In 2004, NASA had evolutionary software design an antenna that met pre-defined performance parameters.[5] The so-called creativity machine, of Stephen L. Thaler, created food containers that are easily stackable by a robot.[6] In the pharmaceutical industry, AI platforms are regularly used to identify existing medicines that may be effective in curing or alleviating other diseases than the ones for which they were initially developed.[7] In particular, cases where the central idea of the invention is attributable to AI, have given rise to speculations that not humans, but AI should be seen as the inventor and attempts have been undertaken to register an algorithm as the inventor in patent applications. Stephen Thaler applied in various jurisdictions for patents that name AI machine DABUS as the inventor. Is this at all possible in patent law?

I. Does patent law allow for invention by a machine?

4 In some jurisdictions, AI may be named as the inventor. Recently, the South African patent office and an Australian court have allowed patents that name an AI as the inventor.[8] Would this also be possible under the European Patent Convention? According to art. 81 European Patent Convention (hereinafter EPC) a European patent application must indicate who the inventor is. Rule 19(1) EPC adds that the application must state the family name, given names and full address of the inventor, and bear the signature of the applicant or his representative. In 2018, a certain Dr. Thaler filed two European patent applications. For these applications, the machine DABUS, a connectionist AI, was indicated as the inventor. The European Patent Office (hereinafter EPO) refused the applications because they failed to mention a natural person as the inventor.[9] That the term 'inventor'

'Patent Law in the Age of AI and IoE. Patent Law based Concepts for Promoting Creation and Sharing of Innovations in the Age of Artificial Intelligence and Internet of Everything' [2019] Les Nouvelles 282-287, R.D. Clifford, 'Intellectual Property in the Era of the Creative Computer Program: Will the true Creator Please Stand Up?' (1997) 71 Tulane Law Review, 1675, B. Hattenbach and J. Glucoft, 'Patents in an Era of Infinite Monkeys and Artificial Intelligence' (2015) 19 Stanford Technology Law Review (32).

3 High-Level Expert Group on Artificial Intelligence, A definition of AI: Main capabilities and scientific disciplines (European Commission, Directorate-General for Communication 2018) p.7 <https://ec.europa.eu/futurium/en/system/files/ged/ai_hleg_definition_of_ai_18_december_1.pdf> accessed 7 December 2021.

4 Daria Kim '"AI-Generated Inventions": Time to Get the Record Straight?' (2020) 69 GRUR International 5, 443–456, Section III. Automation of inventive process: A basic understanding , <https://doi.org/10.1093/grurint/ikaa061> accessed 6 December 2021.

5 J. Bluck, 'NASA 'Evolutionary' software automatically designs antenna', [2004] NASA Release: 04-55AR, <https://www.nasa.gov/mission_pages/st-5/main/04-55AR.html>.

6 D.W. Thaldar and M. Naidoo, AI inventorship: The right decision?, (2021, August 4), p. 2 <https://doi.org/10.31219/osf.io/7uctg>.

7 Peter J. Finnie, 'AI-generated in silico data in patent applications' (2018) 23 Drug Discovery Today (10), 1693-1694, p. 1693.

8 Cases mentioned in D.W. Thaldar and M. Naidoo, AI inventorship: The right decision?, (2021, August 4) <https://doi.org/10.31219/osf.io/7uctg>, p. 2,3. South-Africa: https://www.ipwatchdog.com/wp-content/uploads/2021/07/AP7471ZA00-Notice-of-Acceptance-1.pdf . Australia: Thaler v Commissioner of Patents [2021] FCA 879, https://www.judgments.fedcourt.gov.au/judgments/Judgments/fca/single/2021/2021fca0879 .

9 EPO decisions of 27 January 2020 on applications EP 18 275

should be understood as a natural person is internationally accepted, according to the Office. Moreover, the office argued that the inventor must have legal personality since several rights are attached to the status of inventor. A machine or an AI system would not be able to exercise the rights since it does not enjoy legal personality.

5 The UK IPO, when confronted with two of Dr. Thaler's applications naming the AI machine DABUS as the inventor, refused the applications too for failure to name a natural person as the inventor.[10] This decision was upheld in appeal by Marcus Smith J.[11] Interestingly, Smith J added that his ruling cannot be interpreted as saying that DABUS would itself not be 'capable of an inventive concept'. In fact, he noted: "[…] I am proceeding on the basis that DABUS has 'invented' the inventions the subject of the Applications."[12]

6 In conclusion, The European Patent Convention requires that a natural person is mentioned as the inventor in a patent application, but this does not mean that AI cannot invent. Hence, AI may still be the de facto inventor. Nonetheless, it is important to remember that AI can be used in various ways in the inventive process and even if AI plays a creative role, this does not mean that AI can invent without humans or that humans haven't played crucial and creative role too.

II. Does AI invent without depending on human intervention?

7 Currently, AI is not able to arrive at inventions completely independent from intelligent human intervention. The life cycle of an AI application illustrates this. In 2019, the OECD defined for the purposes of their Recommendation of the Council on Artificial Intelligence an AI life cycle as follows:[13]

> AI system lifecycle: AI system lifecycle phases involve: i) 'design, data and models'; which is a context-dependent sequence encompassing planning and design, data collection and processing, as well as model building; ii) 'verification and validation'; iii) 'deployment'; and iv) 'operation and monitoring'. These phases often take place in an iterative manner and are not necessarily sequential. The decision to retire an AI system from operation may occur at any point during the operation and monitoring phase.

8 Various steps in the life cycle involve humans in the current state of data science. In a first step, an engineer has to describe an observed problem in a mathematical notation: he has to build a model. A general algorithm may need to be adapted to the model and relevant datasets need to be selected and obtained. Currently these activities require human involvement. In a second stage, the algorithm needs to be trained which also may involve humans. For example, in the so-called supervised learning the algorithm needs to receive feedback on its training runs in order to 'learn' or improve itself. Often such feedback comes in the form data annotated by humans. The annotation allows the algorithm to verify its outputs and adapt its inner workings (such as coefficients and thresholds) to improve its performance.

9 It appears that currently it is difficult to say whether the creativity is attributable to man or machine. There are different perceptions. In one perception, humans do the creative work of shaping the framework within which the solution to the technical problem can be found and AI only does the dumb work of searching through the solution-area that the humans have defined. In another perception, the AI system comes up with a solution to a technical problem that human engineers would never have arrived at, given their training.[14] In this view, the role of humans is limited to the preparatory work. Elsewhere, the question of who is the inventor and whether there may be co-inventorship has been addressed extensively.[15] For the purpose of this

163 and EP 18 275 174.

10 Janet Strath, 'DABUS is not a person: Patents Court "retires" AI as an inventor' , (2021) 27 C.T.L.R. (1), 10-12.

11 Thaler v. Comptroller of Patents, Designs and Trade Marks [2020] EWHC 2412 (Pat). The Court applied art. 7 jo. 13 UK Patent Act 1977.

12 Thaler v. Comptroller of Patents, Designs and Trade Marks [2020] EWHC 2412 (Pat) at 46.

13 OECD Recommendation of the Council on Artificial Intelligence (OECD, Paris, 2019a) <https://legalinstruments.oecd.org/api/print?ids=648&lang=en> accessed 20 March 2021, p.7. See also OECD *Artificial Intelligence in Society*, (2019) <https://www.oecd.org/publications/artificial-intelligence-in-society-eedfee77-en.htm> accessed 13 March 2021, Chapter 'The technical landscape', Section 'The AI system lifecycle'.

14 Matthias Schneider, speaking at: EPO conference 'Patenting AI', 30 May 2018, Panel discussion 3 'Post-grant aspects of AI-related patents', recording at 23:01 minutes, available under https://e-courses.epo.org/pluginfile.php/23528/mod_resource/content/3/html/page124198.html , last visited 7 December 2021.

15 Robin C. Feldman and Nick Thieme, 'Competition at the Dawn of Artificial Intelligence' in Björn Lundqvist and Michael S. Gal (eds), Competition Law for the Digital Economy, Edward

article it is sufficient to observe that the role of AI in the inventive process becomes larger, irrespective of whether the role is seen as creative or not. As will become clear below, the increasing use of AI raises relevant questions, even if the role of AI would be characterized as only that of a tool in the hands of human inventors.

C. Inventive step

10 In patent law, an invention is the result of an inventive step if it is not obvious to a skilled person considering the state-of-the-art. Central to the concept of the inventive step is the criterion figure of the person skilled in the art. According to the Guidelines for Examination, he is defined as '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 at the relevant date'.[16] The skilled person is also 'presumed to have had access to everything in the "state of the art"'.[17]

11 Inventive step is assessed using the problem and solution approach. What is obvious, is a cognitive concept. In T-967/97, TBA 3.5.1 decided:[18]

> 3.2. The problem-solution approach is essentially based on actual findings about technical problems and ways to their technical solution, which objectively, i.e. without knowledge of the patent application and the invention to which it relates, were attributable to the knowledge and skills of the skilled person at the priority date.

12 What is obvious depends on knowledge and ability that can be attributed to the PSITA on the priority date. If, based on the PSITA's knowledge and ability, a direction for a solution offers itself up that has a reasonable expectation of success, then if the solution pans out, the solutions is obvious. If the solution is hard to find because no easy route to a solution presents itself to the PSITA, then the solution apparently involves an inventive step.

13 Furthermore, the skilled person is presumed 'to have been in possession of the means and capacity for routine work and experimentation which are normal for the field of technology in question.'[19] Hence, a skilled person may not have the very best instruments but only those that are normal in the field. It is likely that some form of AI will become a normal means for routine work and experimentation in many arts.[20] EU Commissioner Vestager aims for example to achieve that 75% of European businesses take up digital solutions such as cloud computing and AI by 2030.[21]

14 Is patent law open to inventive activity that is at least partially of a non-human origin? To answer this question, we delve in to the rationale for the requirement of inventive step.

I. What is the rationale for inventive step requirement?

15 Patent law is based on a quid-pro-quo, a contrat social.[22] Society grants the inventor for limited times exclusive rights in exchange for publication of the invention. The other side of this medal is that no patent should be forthcoming based on a specification that does not add anything new and inventive to the existing public body of technical knowledge. The monopoly that a patent gives must

Elgar Publishing at 71, UC Hastings Research Paper No. 298 https://ssrn.com/abstract=3218559 accessed 6 December 2021.

16 Guidelines for Examination, Part G, Chapter VII, 3, available at: https://www.epo.org/law-practice/legal-texts/html/guidelines/e/g_vii_3.htm last visited 13 March 2021.

17 Guidelines for Examination, Part G, Chapter VII, 3, available at: https://www.epo.org/law-practice/legal-texts/html/guidelines/e/g_vii_3.htm last visited 13 March 2021.

18 T 0967/97 (Chipkarte/OVD KINEGRAM AG) of 25.10.2001, available at: https://www.epo.org/law-practice/case-law-appeals/recent/t970967du1.html last visited 20 March 2021. Unofficial translation of the original German text: '3.2. Der Aufgabe-Lösungs-Ansatz beruht im wesentlichen auf tatsächlichen Feststellungen über technische Aufgaben und Wege zu deren technischer Lösung, die dem Kenntnisstand und Können des Fachmanns objektiv, d. h. ohne Kenntnis der Patentanmeldung und der Erfindung, die sie zum Gegenstand hat, zum Prioritätszeitpunkt zuzurechnen waren.'

19 Guidelines for Examination, Part G, Chapter VII, 3, available at: https://www.epo.org/law-practice/legal-texts/html/guidelines/e/g_vii_3.htm last visited 13 March 2021.

20 Peter Blok, 'The inventor's new tool: artificial intelligence - how does it fit in the European patent system?' (2017) 39 E.I.P.R. (2), 69-73, p. 71.

21 Vestager, "Check against delivery", Speech by Executive Vice-President Vestager at the press conference on Europe's Digital Decade: 2030 Digital Targets, speech 9 March 2021, available at https://ec.europa.eu/commission/presscorner/detail/en/SPEECH_21_1092 last visited 15 March 2021.

22 David Vaver, 'Intellectual property: still a "bargain"?' (2012) 34 E.I.P.R. (9), 579-586, p. 579 contains an inventory of sources for the view that patents are a quid-pro-quo.

correspond to and be justified by its contribution to the art.[23] Thereto, it is not sufficient that an invention for which a patent is sought is new, i.e. not described in full in the state-of-the-art. If the invention is novel, but nonetheless obvious to a person skilled in the art, a patent should not be forthcoming.

16 From the perspective of the patent as a contrat sociale, it does not matter so much what the relative contribution of the human problem solver and the means for experimentation, such as AI, to the invention are. The invention needs to require more than can be achieved with the skills and knowledge of the skilled person or with normal means of experimentation. The main point is that a patent is granted only for an invention that society does not have at its disposal and that it would not easily obtain. Only if this condition is met, the grant of a patent constitutes an acceptable quid-pro-quo.[24] In this sense, it is in line with the traditional rationale of the inventive step requirement that it should not matter that AI has functioned as the inventor or as a tool. The mandatory disclosure of the inventions as a necessary condition for receiving a patent is an important reason to deem patent protection for inventions by AI desirable.[25]

17 This may be different if in a distant future the role of the human problem solver is marginalized, and generally available Artificial General Intelligence (AGI) solves new technical problems on its own with the help of freely available datasets. In such a situation, it could be argued that society has the solution to new technical problems as good as at its disposal and patent law may no longer be needed. It is however clear that this is a scenario for a very distant future and given the many uncertainties with which it is surrounded, it does not make much sense to explore this further, since it would be highly speculative.[26]

II. AI and inventive step

18 Inventions that a person skilled in the art can arrive at with the help of means for experimentation that belong to his normal toolkit, do not meet the inventive step requirement. To the extent that the means for experimentation become more performant, for example using AI, the nominal person skilled in the art is better versed in the solution of technical problems. This will raise the bar for inventiveness, since inventiveness is that which is beyond the capability of the person skilled in the art, i.e. that which only can be achieved by deployment of the capabilities and means of an inventor. Hence, the bar for inventiveness is raised.

19 Whether the role of the means, such as AI, is creative or not does not matter so much for inventive step. The following example may illustrate this. If the EU Commission succeeds in its policies to create an environment in which the sharing of data becomes commonplace, a person skilled in the art would likely be found to have more data at his disposal as normal means for experimentation. Even if the models and algorithms underlying the AI programs that a PSITA has at his disposal would not change, the PSITA may become more performant and the bar for inventiveness would rise. However, the mere possession of more data is not creative.

20 It may seem as if the question how the requirement of inventiveness should be applied does not raise particular problems. However, a larger role of AI requires that AI means that are normal in the art can be distinguished from other, potentially more performant AI means.[27] Can this be done?[28] It will not be too difficult to establish which AI means are used ‘normally’ in each art. However, it is much less self-evident to obtain a clear picture of the problem-solving capabilities of a normal means if these means involve AI and datasets.

23 Caselaw of the BoA, art. 56 EPC Introduction, available at: https://www.epo.org/law-practice/legal-texts/html/caselaw/2019/e/clr_i_d_1.htm visited 20 March 2021.

24 Chris Dent, ‘An exploration of the principles, precepts and purposes that provide structure to the patent system’ [2008] I.P.Q. 4, 456-477, p. 462-463.

25 A. Comer, ‘AI: Artificial inventor or the real deal?’ (2021) 22 North Carolina Journal of Law & Technology (3), 447-486, p. 479-480.

26 For a different perspective, see: S. Yanisky-Ravid and X. Liu, ‘When Artificial Intelligence Systems Produce Inventions: The 3A Era and an Alternative Model for Patent Law’ (2018) 39 Cardozo Law Review 2215.

27 Ana Ramalho, ‘Patentability of AI-Generated Inventions: Is a Reform of the Patent System Needed?’ (February 15, 2018) <https://ssrn.com/abstract=3168703> or <http://dx.doi.org/10.2139/ssrn.3168703>, p.24-25 notes that it should be possible to know whether an invention came about with the help of AI and that studying trends in the pertinent industry could provide the answer. She does not explore how to assess inventive step once it has been established that it is normal in the pertinent industry to use AI.

28 Assessing the problem solving capabilities of human problem solvers can already be difficult. Ron A. Bouchard, ‘Living Separate and Apart Is Never Easy: Inventive Capacity of the PHOSITA as the Tie That Binds Obviousness and Inventiveness in Pharmaceutical Litigation’ (2007) 4 U. Ottawa L. & Tech. J. 1., p. 18-33 shows this for pharmaceutical patents under Canadian patent law.

D. Approaches to (non-)obviousness

21 Below, three approaches for assessment of the inventiveness of AI-generated inventions are elaborated: result-based criteria, secondary indicia and a cognitive approach.

I. Result based criteria

22 This approach makes use of the automation of the inventive process: by trying to replicate the invention with a reference algorithm and dataset, a precise picture of the non-obviousness of the invention on the filing or priority date may be obtained. This approach has attracted some attention in literature.[29] It is checked whether a reference algorithm – a machine skilled in the art - would be able to arrive at the same or equivalent problem solution as the inventor. If the same or an equivalent invention can be obtained with reference means without undue experimentation, the invention was apparently obvious. It was 'just around the corner' and does not deserve patent protection. The invention was as good as at the disposal of the public on the relevant date. At first sight, this approach holds the promise of a rigorous test for inventive step.[30]

23 Even though at first sight it may be thought to bring a desired level of precision, it is not as simple as it seems. Assessing inventive step with the help of a reference algorithm raises several issues that are elaborated below. A first issue to address is the selection of the data on which the algorithm would operate. Three options for the selection of data on which the algorithm operates can be derived from patent law. They are elaborated below.

1. The reference algorithm operates on same data that the patent applicant used.

24 This dataset would be the best starting point to compare the merits of different algorithms. Nonetheless, the choice of these data would raise several questions. First, the data used by the applicant, may very well be a specialized data collection. The data collection may and often does contribute to the outcome. Letting the reference algorithm work with the same data as the applicant's algorithm, isolates nicely what the contribution of the algorithm to the inventiveness is, because other conditions are kept unchanged. If the algorithm takes the place of the person skilled in the art and becomes the machine-skilled-in-the-art this would show what the machine-skilled-in the-art can do and what is beyond its capabilities and hence, inventive.

25 However, in patent law, it does not matter whether inventiveness is the merit of the algorithm or the merit of choosing a large, specialized, information-rich, and non-public dataset. This is no different from invention-by-humans. An averagely able person skilled with means for experimentation that go beyond what is normal in the industry may arrive at inventive solutions for technical problems. Mutatis mutandis, an ordinary algorithm operating on a rich dataset may come up with inventive solutions. If the crux is in the data and the reference algorithm uses the same data as the inventor, it would arrive at the invention and it may seem as if the invention does not involve an inventive step. However, this only occurs because a highly rich and valuable (non-public) dataset is treated as if it belongs to the state-of-the-art or is a normal means at the disposal of the machine-skilled-in-the-art. Hence, it would still be necessary to find out whether there is inventiveness that derives from the dataset.

26 This approach presumes that the patent applicant makes the dataset he used available for inspection. This may be welcomed by the European Commission, that currently is creating an environment that invites data sharing.[31] For patent applicants however, sharing datasets may make patent law less attractive as an instrument to protect AI inventions, when datasets are used that are non-public and where their non-public nature contributes to the value of the dataset.

29 Ryan Benjamin Abbott, 'Everything is Obvious' (2018) 66 UCLA L. Rev. 2 <https://ssrn.com/abstract=3056915> or <http://dx.doi.org/10.2139/ssrn.3056915> accessed 6 December 2021, p. 42-44. See also Noam Shemtov, speaking at: EPO conference 'Patenting AI', 30 May 2018, Panel discussion 4 'Ethical and societal considerations in relation to AI patented inventions', recording at 19:54 minutes, available under https://e-courses.epo.org/pluginfile.php/23528/mod_resource/content/3/html/page124198.html , last visited 7 December 2021.

30 Hazel V.J. Moir, 'An inventive step for the patent system?' (2013) 35 E.I.P.R. (3), 125-128, p. 126-127 questions the rigor of the current examination of inventive step.

31 The legislation is being updated. Source: Commission, 'A European Strategy for Data' (Communication) COM/2020/66 final, 28 < https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52020DC0066&from=EN > accessed 3 December 2021, at p. 3-4.

27 Perhaps a confidential disclosure of the dataset to the patent examiner may help, but this would immediately raise serious questions about the verifiability of the work of the patent examiner, for example in opposition procedures or before court.

28 A further drawback of the approach discussed here, would be that it may not be very efficient, to first check whether inventiveness derives from the algorithm and subsequently check whether it derives from the dataset. This is relevant because patent offices look at AI with an eye to make their examination processes more efficient.[32]

29 In conclusion, the use of the same dataset that the patent applicant used to assess inventiveness with the help of a reference algorithm does raise issues in terms of confidentiality, transparency of the patent examination and efficiency of the same. Therefore, the question arises whether it may be possible to use different datasets.

2. Data as a normal means of experimentation

30 If the reference algorithm takes the place of the person skilled in the art, then reference data may be the means for experimentation that the person, or perhaps in this case, machine skilled in the art normally has at its disposal. The question is how to arrive at such a dataset. If most companies active in an art, work with non-public datasets, it may be difficult to create a dataset that represents a normal, base-level dataset used in the industry. It does not seem impossible either. With the help of experts in the field it may be possible to compose such a dataset. This dataset would then need to become public, so that it can fulfill its function a reference dataset. This presumes that with one dataset multiple technical problems can be resolved in an industry. It is however unclear whether such a general-purpose dataset exists. If each technical problem in an industry requires a bespoke dataset, this approach becomes very inefficient, if not impossible.

3. Data as part of the state-of-the-art?

31 Art. 54(2) EPC defines the state-of-the-art as 'everything made available to the public by means of a written or oral description, by use, or in any other way, before the date of filing of the European patent application.' Although the state-of-the art may intuitively consist of technical literature, its definition is wider[33] and may also include data, such as patient data. Traditionally, patient data would not give the PSITA much information absent a thorough analysis of the data. Such analysis may require more ingenuity than can be expected from a PSITA. However, with AI on hand, analysis is less of a burden. Hence, mere data can very well be seen as part of the state-of-the-art. If and to the extent that information is seen as state-of-the-art, the PSITA (or MOSITA) is assumed to have access to everything in the relevant state-of-the-art.[34]

32 In this approach, the reference dataset would consist of the most relevant data that are publicly available. In this case, there would be no difficulty with confidential or secret data. It may also allow to create a rather large dataset, especially if many data would be available under non-commercial licenses. Theoretically, a large dataset has the effect of heightening the bar for inventiveness. The extent to which this effect occurs, depends on what prove to be the most relevant datasets: the public or the private ones.

33 A difficult question remains how to compose the reference dataset. With one general dataset for an industry, that can be used for all inventions-by-AI in the sector, a high level of efficiency in assessing inventive step may be achieved. It is not so clear whether this would result in a rather low standard for inventive step. In particular if inventors adapt the datasets they use to the problem at hand, one general reference dataset may constitute a low bar. Theoretically, another option would be to compose a bespoke reference dataset from public data for each invention, but this would probably be too inefficient and give rise to lengthy discussions about what should and should not be included in the dataset. Yet another option would be to include all data that are public in the dataset. The question is whether that would not result in an unacceptably long calculation time.

34 This approach and the other approaches have as a side-effect that it is worthwhile for companies to create information-rich datasets that are not shared and not part of a reference dataset. That is a way to make sure that the inventive step hurdle can be negotiated relatively easy. It would thus work against the policy of the EC to entice companies to share more data. Here, the idea that sharing data helps the collective European industry forward stands diametrically opposite of the individual interest of a company to create a unique dataset as a strategic advantage in competition and patenting.

32 See for example https://www.epo.org/news-events/in-focus/ict/artificial-intelligence.html under 'AI in EPO Tools'.

33 See T 2101/12 (Authentication binding document with signature/VASCO) of 24.1.2018, at 6.5 to 6.8.

34 T 0426/88 (Combustion engine) of 9.11.1990, at 6.1.

35 In conclusion, literature about inventive step of AI inventions tends to focus on the algorithm.[35] The data and in particular the selection of the data that the algorithm operates on are at least as important and raise difficult questions.

36 Also in relation to the algorithm difficult issues may arise. Inventive step is assessed by trying to arrive at the invention with a reference algorithm and a reference dataset. By comparing the outcomes, hopefully something conclusive can be said about the non-obviousness of the invention under scrutiny. The question is to what extent every new problem requires new modelling and adaptation to the algorithm. This may make it difficult to develop an algorithm that functions as a reference. If a more general algorithm delivers weaker results than a tailored algorithm, a general reference algorithm may set the bar for inventive step too low. If a reference algorithm can replicate the invention then this is a strong indication of obviousness. However, if the algorithm does not arrive at the invention, this gives much less information and is probably not usable as a conclusive argument for finding that the invention involves an inventive step.

II. Secondary indicia

37 A second approach, to assess the (non-)obviousness of inventions by AI is to allow secondary indicia to play a bigger role in inventiveness.[36] With the secondary indicia, regard is being had to other objective and externally perceptible circumstances often of an economic nature. A prime example of a secondary indicium is the long felt want. A solution for a technical problem is an indicium of inventiveness, if there has been a longstanding need for the solution while nobody appears to have been able to provide a solution despite attempts to find a solution.[37] Another secondary indicium is the one-way street argument. A surprising solution to a technical problem may nonetheless be obvious, if the PSITA would have arrived at the solution in the fullness of time, because the prior art steers the PSITA in the direction of the solution.[38] In the context of AI, if the prior art steers the PSITA towards the use of a certain model, algorithm and dataset and this combination leads to the invention, then the invention is obvious, even if the way in which the invention solves the technical problem is surprising.

38 Currently secondary indicia have a supporting role in the assessment of inventiveness. The primary test for inventiveness is the problem and solution approach. In literature, the idea has been put forward to give secondary indicia a more prominent role in the assessment of inventiveness, in particular in view of the difficulty of assessing inventiveness of inventions by AI.[39] Secondary indicia most certainly can play a useful role in the assessment of inventiveness of such inventions. The question remains whether sole reliance on secondary indicia for AI inventions is not an admission of weakness. Secondary indicia are merely auxiliary considerations for finding an inventive step.[40] They are mainly relevant in cases where an objective evaluation of inventive step leaves room for doubt.[41] If with some AI cases secondary indicia would be the only criterion because an objective evaluation is not possible, this would be a step backwards. It is the question whether AI changes the assessment of inventive step so drastically that such a step would be necessary. The next section addresses this question.

III. A cognitive assessment

39 An invention involves an inventive step, if, given the closest prior art, the PSITA would not arrive at the invention. The PSITA is 'artificial'. It is not a real existing person, but a criterion figure. The knowledge and capabilities ascribed to the PSITA are in essence the general, shared technical experience in a field.

40 Often inventiveness is based on the effect or result to which the invention gives rise. There is an inventive step if the result or effect is not expected

35 Ryan Benjamin Abbott, 'Everything is Obvious' (2018) 66 UCLA L. Rev. 2 <https://ssrn.com/abstract=3056915> or <http://dx.doi.org/10.2139/ssrn.3056915> accessed 6 December 2021, p. 39-41.

36 Daniele Fabris, 'From the PHOSITA to the MOSITA: will "secondary considerations" save pharmaceutical patents from artificial intelligence?' (2020) 51 IIC (6), 685-708, p.698-703.

37 G. Tritton, R. Davis, M. Edenborough, J. Graham, S. Malynicz and A. Roughton, *Intellectual Property in Europe* (Second Edition, London: Sweet & Maxwell 2002), p.97-98.

38 G. Tritton, R. Davis, M. Edenborough, J. Graham, S. Malynicz and A. Roughton, *Intellectual Property in Europe* (Second Edition, London: Sweet & Maxwell 2002), p. 98-99.

39 Daniele Fabris, 'From the PHOSITA to the MOSITA: will "secondary considerations" save pharmaceutical patents from artificial intelligence?' (2020) 51 IIC (6), 685-708, p. 697-698. For US law, Michael Abramowicz and John F. Duffy, 'The Inducement Standard of Patentability' (2011) 120 YALE L.J. 1590, p. 1603 ff.

40 T 1072/92 of 28.6.1994 at 3.5, 2nd paragraph.

41 T 0877/99 (Refrigerant/DAIKIN) of 31.7.2001 at 3.6.4.

according to the collective experience in the field. Since this criterion looks at the result or effect of an invention, the way in which the invention came about is not of particular importance. This indicates that the criterion is usable irrespective of the way in which the invention came about and in particular, irrespective of the extent to which AI has been used in the process leading up to the invention. If in field X, a synergistic effect is not expected, this remains a valuable insight when assessing inventions having synergistic effects that came about through the involvement of AI.[42] Therewith the existing criteria retain their value, notwithstanding literature that suggests otherwise.[43]

41 That old criteria do retain their value, does not imply that the application of the criteria is not influenced by a change in the process, such as an increasing reliance on AI. A technical solution in an obvious to try situation (even if there is no particular expectation of success) is usually not inventive. That remains the same with an increasing involvement of AI. However, with AI on hand, many more permutations of (possible) solutions can be tried in an efficient way. Hence, with AI an obvious to try situation may occur more often. Another example are neighbouring fields. A PSITA can be expected to look for a solution in a field neighbouring to that of the invention or in a more general field, if the neighbouring or general fields deal with similar problems and the PSITA can be expected to be aware of that field.[44] If the process leading to the invention makes use of AI, it has to be decided too, which neighbouring or more general fields hold potential for a solution. In fact, because of greater efficiency with which AI can scour a search area, the threshold for considering a field as a potential source for a solution may be lowered. Hence where nominally the same rules are applied the result of application may be different. These examples suggest that the threshold for inventive step would rise. That is only a natural development in a situation in which AI makes inventing easier.

42 AI may be used to arrive at the invention, while practicing the invention does not involve AI. An example may be NASA's antenna, mentioned above. AI comes up with the design of the antenna, but building an antenna according to the design does not involve AI. In such a case human experts can and will study the design of the antenna and enrich their knowledge of the field. The use of AI does not mean that human expertise stagnates. With expanding knowledge of the field, the threshold for inventiveness rises.

43 AI may also be part of the invention. An example could be a medication delivery system that based on data about the patient to be treated, calculates a personalized dosage that is optimal for the individual patient. In such a situation, it may not be so easy to see how the invention works. However, application of the invention would most likely require some insight in the way the invention works, either to convince potential users or for compliance with safety or environmental regulations. Although there may be applications that are not so critical that insight in the inner workings of the AI is needed, many will require some form of transparency. It is therefore too early to categorically say that humans skilled in the art have no insight in how AI works and wouldn't be able to assess inventive step.

44 The cognitive approach may no longer work if in a distant future the inventive process is laid completely in the hands of AI and a collective human understanding of the technical field would disappear because of lack of need for it. It is at present unclear whether such situation will ever occur. Given the present uncertainties about such a situation it is too early to discuss such a situation. Moreover, might such a situation occur then bigger questions than inventive step would need to be addressed first. For example, if AI takes care of inventive processes from A-to-Z, would such mean that the cost of inventing dramatically decreases? If so, would that not open discussions about much profounder adaptations to patent law?

E. Conclusion

45 AI can help solve technical problems. The type of support from AI can vary. AI may be a simple instrument in the hands of the human problem solver. AI may also come up with the central idea underlying an invention. Patent law is open to protection of new and inventive technical solutions, also if they arise from the use of AI. In literature, the question has been raised how to assess inventiveness in case AI has been used to arrive at an invention. At first sight, patent law can easily deal with this situation. As ever more sophisticated AI means enter the normal toolkit of the PSITA, the bar for inventiveness will rise automatically. It is also relatively easy to establish what AI means are normally used in an industry. However, it is more difficult to assess

42 T 1814/11 (Synergistische Fungizide Mischung/BASF SE) of 6.2.2013, at 3.5.

43 Daniele Fabris, 'From the PHOSITA to the MOSITA: will "secondary considerations" save pharmaceutical patents from artificial intelligence?' (2020) 51 IIC (6), 685-708, p. 697; Ryan Benjamin Abbott, 'Everything is Obvious' (2018) 66 UCLA L. Rev. 2 <https://ssrn.com/abstract=3056915> or <http://dx.doi.org/10.2139/ssrn.3056915> accessed 6 December 2021, p. 35-37.

44 T 0176/84 (Pencil sharpener) of 22.11.1985, at 5.3.1.

what the capability of normal AI means is. This article distinguishes three approaches. A first approach seeks to define reference AI means. These means can be used to try to replicate an invention, whereby the idea is that if the reference means fail, the invention must be inventive. This approach has attracted attention in literature and on first sight, is also interesting from the perspective of increasing efficiency of the examination processes in patent offices by harnessing the possibilities of AI. This article is critical of this approach. Literature about this approach has focused on reference AI algorithms, but largely ignored the issue of the datasets on which the algorithms operate, even though the data is of critical importance to the problem solving capacity of AI.[45] When seeking to define reference datasets, it appears that values such as effectivity, transparency, verifiability and efficiency may come under pressure, making this approach less attractive. A second approach circumvents the issue by focusing on secondary indications of inventiveness. The question is whether secondary indicia give robust enough results. A third approach, revisits what it actually means that AI is used in inventive processes and how the problem and solution approach is used in practice. It appears that the use of AI does not mean that human involvement is marginalized. A human understanding of what inventive results are does not disappear and can co-evolve with the use of AI. Current means of assessing inventive step remain relevant at least until a general artificial intelligence makes its appearance and that lies in a future that is too far away, to be of current concern.

45 Chr. Hartmann, J.E.M. Allan, P.B. Hugenholtz, J.P. Quintais, and D. Gervais, Trends and Developments in Artificial Intelligence. Challenges to the Intellectual Property Rights Framework. Final Report (Luxembourg: Publications Office of the European Union 2020) <https://www.ivir.nl/publicaties/download/Trends_and_Developments_in_Artificial_Intelligence-1.pdf> accessed 13 March 2021, address the issue of data, but in more limited context.