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By Ernest Fok*

While international patent regimes have disallowed computers from being named as inventors on a patent, the U.S. patent regime has an opportunity to promote innovation and reshape the patent landscape by recognizing artificial intelligence ("AI") systems as inventors for patent applications. The main benefit of this would be driven by computer algorithms that incorporate modern machine learning techniques to generate patentable subject matter while eliminating the need for humans in the invention process. This computer algorithm, which will be referred to in this paper as "inventing-AI," would not be recognized as inventors by the United States Patent and Trademark Office because it only allows for natural persons to be inventors on a patent application.

This paper argues that the U.S. patent regime is poised to tip the global balance between economic incentives and the cost of society by recognizing inventing-AI as inventors. This paper will explore the problems posed by the USPTO's inventorship requirements, the technology behind inventing-AI and its creative capabilities, and the current state of AI inventorship among major international patent regimes. Later, it will address why AI inventorship makes sense for the U.S. despite the global trend against granting computers such rights. The U.S. is poised to promote the Constitutional goal of advancing "the progress of science and the useful arts" for the betterment of society. Lastly, the paper will briefly discuss some major challenges that would arise from recognizing inventing-AI as inventors and a potential solution to mitigate those issues.

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INTRODUCTION

Artificial intelligence ("AI") can revolutionize "the nature of the innovation process and the organization of [research and development]."[1] Currently, the discovery of productive new ideas remains constant despite a sharp climb in research investment, whether it is looking at drug discovery, semiconductor research, medical innovation, or efforts to improve crop yields.[2] For example, human researchers have only explored a small snippet of the estimated billions of "potentially drug-like molecules" in existence.[3] These chemists often make educated guesses as to a compound's suitability for medicines, drawing upon their knowledge of molecular structures and chemical properties to synthesize and test the compound's efficacy.[4] Unfortunately, this often results in failure because finding that breakthrough molecule has become more difficult and costly as drug discovery has grown increasingly complex and saturated with data.[5] Despite pharmaceutical and biotechnology industries investing significant amounts of money into research, the number of new drugs based on novel molecules has remained flat in the past decades.[6]

This dynamic is changing as modern AI reinvents what it means to innovate. Methods such as machine learning and deep artificial neural networks enable AI to recognize images, comprehend language, and explore new molecule combinations.[7] It does so in ways that a human would not consider, such as when an AI defeated the best human players of the complex board game "Go" using "winning strategies that no human had thought to try."[8] When applying this to drug discovery, a deep learning AI trained on vast sets of experimental data and chemical knowledge "could come up with novel compounds that scientists [have] never imagined."[9] So why hasn't AI revolutionized research, development, and innovation to efficiently make impactful, patentable discoveries?

While these sophisticated AI systems can mimic human acts of intelligence and creativity, these computers are not recognized as inventors in patent applications worldwide.[10] As recently as January 2020, the European Patent Office ("EPO") denied inventorship to inventing-AI because public policy and practicality

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[1] David Rotman, *AI is Reinventing the Way We Invent*, MIT Tech. Rev., March 1, 2019, at 60, https://www.technologyreview.com/s/612898/ai-is-reinventing-the-way-we-invent/.
[2] *Id.*
[3] *Id.* at 59.
[4] *Id.*
[5] *Id.*
[6] *Id.*
[7] David Rotman, *AI is Reinventing the Way We Invent*, MIT Tech. Rev., March 1, 2019, at 62, https://www.technologyreview.com/s/612898/ai-is-reinventing-the-way-we-invent/.
[8] *Id.* at 61.
[9] *Id.*
[10] NOAM SHEMTOV, A STUDY ON INVENTORSHIP IN INVENTIONS INVOLVING AI ACTIVITY 35 (2019).

considerations outweighed the benefits of recognizing AI systems as inventors.[11] The EPO also stated that "the understanding of the term inventor as referring to a natural person appears to be an internationally applicable standard."[12] Most patent jurisdictions continue to only recognize human inventorship, creating uncertainty and friction for those looking to use AI systems to automate the discovery and creation of patentable subject matter.[13] By refusing to recognize AI systems as inventors, these patent regimes forgo promoting AI as a cost-efficient innovator in today's society.

Though the international trend is to maintain the status quo, this paper will specifically look at why the U.S. patent system is well positioned to deviate from this international trend against non-human inventorship and recognize AI inventorship. The discussion is divided into two parts.

Part I begins by describing U.S. inventorship requirements and the problem it poses for AI systems. The first requirement is that the patent application must name one or more inventors who must be "individuals," which excludes non-human persons such as computers and corporations.[14] The second requirement is that the inventor participates in the conception of an invention.[15] Part I identifies and explains what types of AI systems can satisfy this requirement. Later on, Part I elaborates on how major international patent regimes are generally approaching AI inventorship and distinguishes why the U.S. patent system should recognize inventing-AI as inventors.

Part II details how AI inventorship creates a better environment for innovation and patenting in the U.S. For instance, the U.S. patent system can gain a competitive edge by recognizing AI inventorship when other patent regimes have not. Furthermore, encouraging development and use of machines capable of independent invention can greatly reduce the cost of invention when combined with automation. Lastly, AI inventorship can shift behaviours in the patent marketplace towards behaviours like licensing and open sourcing that provide greater societal benefit. Extending inventorship to AI systems maximizes the economic and societal benefits that come with exclusive patent rights. This also comes with challenges related to patent ownership, which Part II will discuss in detail alongside a proposed statutory solution to this issue. Lastly, Part II concludes with how the U.S. patent system stands to positively shape the domestic and international patent landscape through AI inventorship.

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[11] *See EPO Publishes Grounds for its Decision to Refuse Two Patent Applications Naming a Machine as Inventor*, EUROPEAN PATENT OFFICE (Jan. 28, 2020), https://www.epo.org/news-events/news/2020/20200128.html.
[12] *Id.*
[13] *Id.*
[14] Manual of Patent Examining Procedure § 2137.01 (9th ed. Rev. Jan. 2018) [hereinafter MPEP].
[15] *See* Townsend v. Smith, 36 F.2d 292, 295 (C.C.P.A. 1929).

PART I

I. THE PROBLEM WITH INVENTORSHIP

To drastically change research and development, AI must be infused into each step of the inventive process. When human involvement can be minimized or eliminated through automation, inventing becomes faster and more cost efficient.[16] These inventions can then be patented, granting the inventor the right to exclude others from making, using, offering for sale, or selling or importing the invention.[17] This government-sanctioned monopoly provides a valuable incentive to innovate, but problems arise where AI obviates the need for humans in the creative process.

Under the Patent Act, "whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent."[18] Inventorship focuses on who invented the patent's subject matter[19], and the inventor who conceives of the invention does not need to reduce it to practice.[20] It sets forth two main requirements.

First, a patent application requires one or more inventors to be named,[21] and these individuals then declare themselves as inventor(s) under oath.[22] An individual cannot be a legal entity, such as a corporation.[23] Secondly, the inventor(s) must have participated in the invention's "conception," which is defined as "the complete performance of the mental part of the inventive art."[24] This process includes making "non-obvious" discoveries.[25] It also requires inventors to demonstrate an "inventive concept" beyond ineligible patent subjects.[26] As a result, the inventor creates an innovation that meets the following conditions for patentability: useful, novel, and non-obvious.[27]

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[16] *See* Rotman, *supra* note 1, at 63 ("To really change materials research, you need to attack the entire process: 'What are the bottlenecks? You want AI in every piece of the lab' . . . Machine learning could speed up each of those steps.").
[17] 35 U.S.C. § 154.
[18] 35 U.S.C. § 101.
[19] MPEP § 2137.01 (9th ed. Rev. Jan. 2018) ("Unless a person contributes to the conception of the invention, he is not an inventor.").
[20] *Id.* (Reduction to practice is satisfied when a patent application having a sufficient disclosure is filed or when the invention is actually carried out and is found to work for its intended purpose).
[21] *Id.*
[22] 35 U.S.C. § 100(f).
[23] 35 U.S.C. §§ 115-16.
[24] Townsend v. Smith, 36 F.2d 292, 295 (C.C.P.A. 1929).
[25] Intellectual Ventures I LLC v. Symantec Corp., 838 F.3d 1307, 1324 (Fed. Cir. 2016).
[26] Alice Corp. Party Ltd. v. CLS Bank Int'l, 573 U.S. 208, 271 (2014).
[27] 35 U.S.C. §§ 101-103.

Thus, the main problem presented is whether "a computer autonomously conceiving of a patentable invention" can satisfy the patent application and "mental act" requirements.[28]

II. THE NAMED INVENTOR(S) REQUIREMENT

A. In Theory

From a constitutional standpoint, a computer can be an inventor. The U.S. Constitution grants Congress the power "[t]o promote the progress of science and useful arts, by securing for limited times to authors and inventors the exclusive right to their respective writings and discoveries," leaving the term "inventor" open to interpretation.[29] In 1973, the Supreme Court held that terms "authors" and "inventors" have "not been construed in their narrow literal sense but, rather, with the reach necessary to reflect the broad scope of constitutional principles," suggesting that authors and inventors can be defined broadly to promote the progress of science and useful arts.[30] In turn, both a literal and broad interpretation of the Constitution's use of "inventor" suggests non-humans can be inventors.

B. In Practice

However, modern inventorship is limited to natural persons in practice. Current notions of conception are confined exclusively to natural persons because AI has no mind to complete the "mental act" required to invent or discover.[31] Moreover, the Supreme Court has more recently interpreted patent-eligible subject matter as "anything under the sun that is made by *man*," suggesting only humans can generate inventions.[32] Furthermore, the Dictionary Act provides that "[i]n determining the meaning of any Act of Congress . . . the [word] . . . 'individual,' shall include every infant member of the species homo sapiens."[33] Likewise, Congress has stated that corporations cannot be named as an inventor.[34] Lastly, the Federal Circuit stated that "only natural persons may be 'inventors'"[35] and that "[p]eople conceive, not companies," suggesting legal persons such as businesses are not capable of conception.[36] Legal precedence so far only supports human inventorship.

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[28] Ryan Abbott, *I Think, Therefore I Invent: Creative Computers and Future of Patent Law*, 57 B.C. L. REV. 1079, 1096 (2016).
[29] U.S. CONST. art. 1, § 8, cl. 8.
[30] Goldstein v. Cal., 412 U.S. 546, 561 (1973).
[31] Daryl Lim, *AI & IP: Innovation & Creativity in an Age of Accelerated Change*, 52 AKRON L. REV. 813, 858 (2018).
[32] Diamond v. Chakrabarty, 447 U.S. 303, 309 (1980) (emphasis added).
[33] 1 U.S.C. § 8(a).
[34] 35 U.S.C. § 100(f).
[35] Beech Aircraft Corp. v. EDO Corp., 990 F.2d 1237, 1248 (Fed. Cir. 1993) (referring to 35 U.S.C. §§ 115-118).
[36] New Idea Farm Equip. Corp. v. Sperry Corp., 916 F.2d 1561, 1566 n.4 (Fed. Cir. 1990).

From an academic perspective, several scholars have emphasized that exclusive human inventorship is critical. One view is that inventorship is a moral right where inventors have a right to receive credit for their works.[37] This is seen as complementary to the utilitarian view of patents as rewards for inventors that bravely "releas[e] intellectual property to the world."[38] It supports the social norm that drives inventors to patent.[39] For example, the patent itself acts as a credential for the inventor to signal to society that the inventor of the patent is worthy of respect.[40] These rights do not apply to artificial intelligence systems that lack consciousness and self-awareness.[41]

III. THE "MENTAL ACT" REQUIREMENT

Though modern AI does not possess volition, it is technologically capable of creativity and imagination to satisfy the "mental act" required for invention.[42]

Human inventorship continues to dominate because computers have commonly been used as tools to assist human inventors to reduce an invention to practice, but are not often participating in the invention's conception—a mandatory requirement for inventorship.[43] With more recent AI developments, computers took on a more "substantive role" in the inventive process by automating data analysis or conducting pattern recognition, but may still fail to contribute to conception[44] because the computer is merely implementing statistical or mathematical concepts in a series of routine and ordinary tasks under *Alice*.[45] However, AI has grown more sophisticated by moving from a simple program that executes a static algorithm implemented by a human programmer to a complex system utilizing artificial neural networks and machine learning that mimics the dynamic aspects of human

[37] Jason Rantenen & Sarah E. Jack, *Patents as Credentials*, 76 WASH. & LEE L. REV. 311, 314 (2019); *see* Czarnik v. Illumina, Inc., 437 F. Supp. 2d 252, 256 (D. Del. 2006) (concluding that the plaintiff had standing to correct inventorship because "he ha[d] suffered harm to his reputation and standing in the scientific community"); *see also* Chou v. Univ. of Chi., 254 F.3d 1347, 1359 (Fed. Cir. 2001) ("[B]eing considered an inventor of important subject matter is a mark of success in one's field . . . Pecuniary consequences may well flow from being designated as an inventor.").

[38] Rantenen, *supra* note 37, at 316.

[39] Rantenen, *supra* note 37, at 315-16.

[40] Rantenen, *supra* note 37, at 316.

[41] Shemtov, *supra* note 10, at 35.

[42] *See* Abbott, *supra* note 28, at 1083.

[43] Abbott, *supra* note 28, at 1093.

[44] Abbott, *supra* note 28, at 1093.

[45] *See* Alice, 573 U.S. at 217 (2014) (The Court set forth a two-prong test for determining patent-eligibility, in which the first step is determining whether the claims are directed to a patent-ineligible concept, such as an abstract idea and, if so, the second step is considering "the elements of each claim both individually and as an ordered combination to determine whether the additional elements transform the nature of the claim into a patent-eligible application", in search for an "inventive concept.") (internal quotation and citations omitted).

creativity.[46] These techniques emulate the brain's broad methods for processing information, but without human constraints such as the body's limited energy output or skull size.[47] They enable modern AI to learn and adapt to novel situations by using training data and learning algorithms to generate predictions beyond what it was originally programmed for,[48] suggesting that the computers are operating in a non-routine, transformative manner to generate inventions that meets the patent subject matter eligibility requirements set forth in *Mayo* and *Alice.*[49] Though humans are "necessarily involved in the creative process" whether its developing or using AI, there should be no reason for these humans to qualify as the inventor where the AI "autonomously develop[s] useful information" and "creates a patentable result in an area not foreseen" by its creator or user.[50] These developments suggest that inventorship should be extended AI systems autonomously capable of independent invention. These systems, henceforth referred to as "inventing-AI," are capable of the "mental act" required for inventorship in instances where no natural person has contributed to the invention's conception. To understand how inventing-AI invents like humans do, it is important to briefly delve into the technology.

IV. INVENTING AI

Inventing-AI are artificial intelligence systems that can be categorized as "weak AI" or "strong AI" that are "capable of the same level of invention and creativity as any individual person."[51] As a result, these systems can perform the mental act required of inventors.

Weak AI systems are designed to solve a narrowly tailored problem such as winning in well-defined board games or creating new toothbrush designs, whereas strong AI represents generalized intelligence akin to human mental capabilities such as reasoning and problem solving."[52] An example of this is IBM's Watson, which utilizes logical deduction, statistical regression models, and massive databases of human knowledge and expertise to mimic human creativity in a wide variety of settings such as competing on complex human game shows like *Jeopardy!* or developing new food recipes.[53]

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[46] Russ Pearlman, *Recognizing Artificial Intelligence (AI) as Authors and Inventors Under U.S. Intellectual Property Law*, 24 RICH. J. L. & TECH. 2, 37 (2018).
[47] Hal Hodson, *DeepMind and Google: The Battle to Control Artificial Intelligence*, THE ECONOMIST (Mar. 1, 2019), https://www.1843magazine.com/features/deepmind-and-google-the-battle-to-control-artificial-intelligence.
[48] Sikander Khan, Associate, Haynes, Beffel & Woldfeld LLP, Lecture at Santa Clara University School of Law (Oct. 30, 2019).
[49] Mayo Collaborative Servs. v. Prometheus Laboratories, Inc., 566 U.S. 66 (2012).
[50] Abbott, *supra* note 28, at 1095.
[51] Pearlman, *supra* note 46, at 11.
[52] Pearlman, *supra* note 46, at 11; *see also* Abbott, *supra* note 28, at 1084-86.
[53] Abbott, *supra* note 28, at 1090-91.

Whether classified as weak or strong AI, inventing-AI utilizes machine learning which "involves building and adapting [computational] models" that "teach computers how to learn and act without being explicitly programmed."[54] Artificial neural networks are an example of one type of machine learning model. These neural networks are digital embodiments that simulate the human brain's "fundamental mechanisms responsible for idea formation," thus enabling the system to generate novel patterns of information and adapt to new scenarios without additional human input.[55] The AI's software adaptations are not coded by human beings. Instead, the AI undergoes a self-assembling process by modifying how its artificial neural networks communicate with each other as the system encounters input data,[56] much like how the human brain's neurons communicate with each other to understand and adapt to inputs from human senses.[57] There are also several other machine learning algorithms that are "not modeled after the human brain or evolutionary processes" but still enable inventing-AI to generalize information and knowledge in ways that even human experts have difficulty achieving.[58] Given these technological developments, inventing-AI can perform the mental acts required for human inventorship.

In fact, this has been indirectly recognized by the U.S. Patent Office ("USPTO"). In 2005, Dr. John Koza was awarded the patent on an invention created by an inventing-AI known as the "invention machine," which utilized genetic programming (modeled after evolutionary processes) to create an improvement to a known controller system without the aid of a "database of expert knowledge" and "without knowledge about existing controllers."[59] The prosecution history did not mention the use of AI to develop the invention, and the patent was issued to Dr. Koza despite Koza's admission that "his legal counsel advised . . . that [Koza's] team consider themselves inventors" even though "the whole invention was created by a computer."[60] Despite this admission, the USPTO "seem[ed] to require only that a natural person be registered for the patent" and upheld the patent because the application "[met] its other stringent requirements."[61] In this instance, the patent application listed a human inventor who did not take part in conception. This example illustrates that an AI system can conceive an invention satisfying inventorship and substantive patent requirements in the U.S.

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[54] DeepAI, *What is Machine Learning?*, https://deepai.org/machine-learning-glossary-and-terms/machine-learning (last visited Dec. 13, 2020).
[55] Abbott, *supra* note 28, at 1084-85.
[56] Abbott, *supra* note 28, at 1084-85.
[57] DeepAI, *supra* note 54.
[58] Abbott, *supra* note 28, at 1088-89.
[59] Abbott, *supra* note 28, at 1087; U.S. Patent No. 6,847,851 (filed July 12, 2002) (issued Jan. 25, 2005) (listing Dr. John Koza as the inventor for an AI-generated invention that involved no human intervention; AI's involvement not disclosed to Patent Office).
[60] Abbott, *supra* note 28, at 1088.
[61] Pearlman, *supra* note 46, at 23.

Where inventing-AI generated patentable subject matter and met the substantive novelty, non-obvious, and useful requirements, the U.S. patent regime has indirectly, though not officially, recognized AI inventorship.

V. THE CURRENT STATE OF AI INVENTORSHIP

To better contextualize what the U.S. patent system can gain from recognizing AI inventorship, it is important to understand how other major patent regimes are approaching this topic.

A. Global Trend

As reported in a recently commissioned 2019 study by the EPO broadly discussing AI inventorship across prominent patent regimes, none of the major patent jurisdictions (U.S., China, Japan, Republic of Korea, European Union) allow for AI systems to be inventors.[62] Notably, each jurisdiction differed in its terminology and tests to define an inventor but maintained an overall uniform objective: "to identify the person that was responsible, wholly or partially, for what may be described as the intelligent and creative conception of the invention."[63] Delving further, the study detailed the EPO's "strict definition of inventorship limited to humans" and why this policy is "suitable for the legal and technological landscape both at present and in the near future." [64] The study emphasizes three main rationales for the EPO's approach and generalizes them to explain why recognizing AI inventorship is unnecessary for other patent regimes.

First, extending inventorship beyond natural persons would have largely negative consequences.[65] For instance, the European Patent Convention's ("EPC") framework safeguards the inventor's right of entitlement and right of attribution under EPC Article 60.[66] These rights are valued by human inventors, but would be meaningless when applied to an AI system.[67] These rights provide value to human inventors. The two main functions relate to personhood interests: (1) creating a pecuniary incentive to invent and (2) increasing reputational gain.[68] Granting such rights would entail granting personhood to the inventing-AI, but the ensuing legal hurdles make these solutions a mere gesture at best and very impractical at worst.[69] For example, concepts of ownership and employment cannot be successfully applied to AI systems under the EPO's legal framework since AI systems cannot own property nor can they be a party to employment relationship.[70] Thus, there are

[62] Shemtov, *supra* note 10, at 5.
[63] Shemtov, *supra* note 10, at 5.
[64] Shemtov, *supra* note 10, at 34.
[65] Shemtov, *supra* note 10, at 8.
[66] Shemtov, *supra* note 10, at 25.
[67] Shemtov, *supra* note 10, at 24-25.
[68] Shemtov, *supra* note 10, at 23 (citing Jeanne Fromer, *Expressive Incentives in Intellectual Property*, 98 VA. L. REV. 1745 (2012)).
[69] Shemtov, *supra* note 10, at 27.
[70] Shemtov, *supra* note 10, at 6.

no "convincing rationales" to apply the EPC rules on attribution and entitlement to an AI system.[71] In applying this to the present legal landscape, other major patent regimes are "not equipped to facilitate a definition of inventorship that includes AI systems" because inventorship involves concepts of ownership, employment, and entitlement that are meaningless to AI systems.[72]

Second, the study anticipates AI inventorship being unwarranted even if the technology advances so significantly that the process of invention would be so removed from human involvement that no human actor could be considered an inventor.[73] It found that patents with substantial AI involvement are still likely to be granted even without the recognition of computers as inventors as long as human inventors can be identified.[74] For instance, EPO policy dictates that the person who recognizes the importance and utility of the invention is also an inventor.[75] This approach is shared by "all of the relevant patent jurisdictions grant patents where the inventor comes by the core of the inventive concept . . . by dumb luck rather than real inventive effort."[76] When applying this to inventing-AI, the person who selects the machine learning algorithms, chooses the relevant parameters, or identifies the input data could be an inventor even if the inventing-AI's output was somewhat unpredictable. Since AI systems involve many actors—such as programmers, users, and investors—identifying who is an inventor should be carried out on a case-by-case basis.[77] The study recommends that other patent regimes would benefit from approaching inventions that involve AI activity in a similar manner because it would establish a uniform position towards inventorship.[78]

In sum, the report concludes that the "present legal landscape" for major patent regimes is "not equipped to facilitate a definition of inventorship that includes AI systems."[79] The legal arguments against AI inventorship expressed in the EPO's study are applicable to the U.S. patent regime. However, the U.S. patent regime could embrace AI inventorship to shift the patent landscape and capitalize on the growing investment in AI technologies.

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[71] Shemtov, *supra* note 10, at 34.
[72] Shemtov, *supra* note 10, at 35.
[73] Shemtov, *supra* note 10, at 34.
[74] Shemtov, *supra* note 10, at 24.
[75] Shemtov, *supra* note 10, at 21 ("Whether encountering the inventive concept of the invention by pure luck and realizing its utility and significance or whether by doing so after examining the output of an AI system, the relevant person may be considered as the inventor and their involvement may be described as intellectual or creative conception.").
[76] Shemtov, *supra* note 10, at 35.
[77] Shemtov, *supra* note 10, at 31.
[78] Shemtov, *supra* note 10, at 35.
[79] Shemtov, *supra* note 10, at 35.

B. United States

First, the Patent Act requires that an inventor be listed on a patent application.[80] Listing a natural person who did not participate in conceiving of an inventing-AI's invention may give rise inequitable conduct.[81] This also applies to patent applicants who intentionally falsify inventorship to the USPTO on any issued patent.[82] In this instance, the inventing-AI's programmer or end-user would not be classified as a joint inventor. Humans can provide machines with a task and materials needed to invent, but this does not make her an inventor. Inventorship requires contributing to the conception of the invention, and inventors may adopt ideas, suggestions, and materials from others as long as they maintain intellectual dominion over making the invention.[83] Similarly, a programmer or user who directs the inventing-AI to generate inventions within a given domain may not qualify as a co-inventor.[84] Patentees seeking to enforce their rights might have their suits dismissed for non-joinder if a court determines that the patent does not name all joint inventors.[85] In light of this, there appears to be no case law or controversies related to non-human inventors, so it is likely that an AI would not qualify as a sole inventor, let alone as a joint inventor.[86]

Despite these hurdles, inventorship over the inventing-AI's invention is possible because a person may qualify as an inventor by being the first individual to recognize and appreciate an existing invention.[87] Under this circumstance, a person discovers rather than creates an invention. It follows that the person's understanding of the invention's importance would qualify the person as an inventor.[88] This suggests any inventing-AI's inventions are only patentable when an individual subsequently discovers them.[89] While this is a solution, it raises a

[80] 35 U.S.C § 111(a).
[81] 35 U.S.C. § 101 ("Whoever invents or discovers . . . may obtain a patent thereof, subject to the conditions and requirements of this title."); 35 U.S.C. § 115(a) ("An application for patent . . . shall include, or be amended to include, the name of the inventor for any invention claimed in the application.").
[82] MPEP § 2137.01 (2018) (USPTO patent examination procedure for inventorship; states incorrectly identifying inventor on patent application is grounds for rejection).
[83] Fiers v. Revel, 984 F.2d 1164, 1168 (Fed. Cir. 1993) (A person who does not contribute to the conception of an invention is not an inventor. Reduction to practice is per se irrelevant for inventorship, except for simultaneous conception and reduction to practice.).
[84] *Ex parte Smernoff*, 215 U.S.P.Q. 545, 547 (Bd. App. 1982) ("[O]ne who suggests an idea of a result to be accomplished, rather than the means of accomplishing it, is not a[] coinventor.").
[85] Lim, *supra* note 31, at 860.
[86] Pearlman, *supra* note 46, at 24.
[87] Abbott, *supra* note 28, at 1098.
[88] *See* Silvestri v. Grant, 496 F.2d 593, 597 (C.C.P.A. 1974) ("[A]n accidental and unappreciated duplication of an invention does not defeat the patent right of one who, though later in time, was the first to recognize that which constitutes the inventive subject matter.").
[89] Abbott, *supra* note 28, at 1098.

challenging question of who should be listed as the inventor—should it be the AI programmer, the end-user, the person providing the training data, or the AI creator? Allowing AI inventorship may shift this analysis to a more efficient point in the patenting timeline.

Second, though the EPO-commissioned study suggests that inventing-AI is still in its infancy such that its inventive processes can always be attributable human involvement, the USPTO has already unknowingly granted patents for inventions created by inventing-AI.[90]

Third, the U.S. Constitution grants Congress the power "[t]o promote the progress of science and useful arts, by securing for limited times to authors and inventors the exclusive right to their respective writings and discoveries, leaving the term "inventor" open to interpretation.[91] In August 2019, the USPTO requested comments on patent-related issues regarding AI inventions to decide how to interpret "inventor."[92] This question was decided in April 2020, when the USPTO issued a final decision[93] concerning two recent patent applications simultaneously filed with the USPTO and EPO that listed an inventing-AI as the inventor: one for an improved beverage container, the other for a light-emitting device used in search-and-rescue missions.[94] The EPO refused these two patent applications in November 2019, stating that the European patent framework requires an inventor designated in a European patent to be natural person.[95] The U.S. came to a similar conclusion in April 2020, relying on "current statutes, case law, and USPTO regulations and rules" to "limit inventorship to natural persons."[96]

PART II

I. CONSIDERING AI INVENTORSHIP IN THE U.S.

AI inventorship has not been recognized in the U.S. despite a dramatic increase in the development and use of AI technologies. In 2017, an economic study showed that 550 start-ups using AI as a core part of their products raised $5 billion

[90] Abbott, *supra* note 28, at 1099.
[91] U.S. CONST. art. I, § 8, cl. 8.
[92] Request for Comments on Patenting AI Inventions, 84 Fed. Reg. 44, 889 (Aug. 22, 2019).
[93] FlashPoint, 2020 Dec. Comm'r Pat. 16/524,350.
[94] *When Innovation Invents: Artificial Intelligence Issues at the U.S. Patent and Trademark Office*, JONES DAY (Aug. 2019), https://www.jonesday.com/en/insights/2019/09/when-innovation-invents; *see also Patent Applications*, THE ARTIFICIAL INVENTOR PROJECT, http://artificialinventor.com/patent-applications/ (last visited Nov. 16, 2019) (listing patent specifications for two inventions independently created by AI system named "DABUS").
[95] *EPO, supra* note 11 ("[T]he applications EP17275163 and EP18275174 were refused by the EPO . . . on grounds that they do not meet the legal requirement of the [EPC] that an inventor designated in the application has to be a human being, and not a machine.").
[96] FlashPoint, *supra* note 93.

in funding with 60% of that funding going into American companies.[97] Moreover, the American Intellectual Property Law Association estimated the annual investments directly in AI technologies in 2017 reached $26-39 billion.[98] Alongside this investment, the employment market for deep learning researchers has boomed with some researchers obtained through mergers and acquisitions being valued at nearly $10 million.[99] AI commercialization is expected to reach $190 billion by 2025.[100]

While investment in AI has dramatically increased, the USPTO has not been receiving a similar increase in applications claiming computers as the inventor.[101] This suggests that applicants are choosing not to disclose the AI in the inventive process.[102] This trend of obscuring AI involvement in the inventive process highlights the legal risks of listing a non-human inventor. While the practice of listing humans who utilize inventing-AI has worked for the U.S. system so far, it fails to further incentivize the use of inventing-AI.[103] For example, corporations, research institutions, and investors may be dissuaded from using inventing-AI to fully automate innovation because it amplifies the uncertainty and administrative burden of obtaining a patent on the resulting invention. By requiring a natural person to be listed as an inventor, the U.S. unnecessarily maintains a cost-inefficient status quo. Should the U.S. recognize AI inventorship, it could drastically change industries whose R&D costs have been ballooning just to maintain historical rates of useful, patentable discoveries.[104] AI inventorship is a critical step in unlocking inventing-AI's potential to promote innovation within the patent landscape. Several reasons supporting AI inventorship are discussed below.

II. SUPPORTING THE ECONOMIC-UTILITARIAN RATIONALE

The rationale for AI inventorship is strongest under a utilitarian-economic incentive theory ("UEI") because the Constitution provides "explicit rationale" for granting patent protection to encourage innovation.[105] Inventorship and the subsequent patent ownership rights are necessary to economically incentivize

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[97] *The 2016 AI Recap: Startups See Record High in Deals and Funding*, CB INSIGHTS (Jan. 19, 2017), https://www.cbinsights.com/research/artificial-intelligence-startup-funding/.
[98] Aaron Abood, *Deep Learning – A Practical Perspective for Patent Practitioners*, AM. INTELL. PROP. L. ASSOC. (2017).
[99] *Id.*
[100] *Id.*
[101] Abbott, *supra* note 28, at 1080 n.5 (citing Ben Hattenbach & Joshua Glucoft, *Patents in an Era of Infinite Monkeys and Artificial Intelligence*, 19 STAN. TECH. L. REV. 32, 44 & n.70 (2015) (Abbott noted no pertinent results from "a search for patent cases discussing genetic programming or computer-aided drug discovery (perhaps the two most common means of computerized inventive activity)" and that "[o]f a sampling of issued patents that were conceived wholly or in part by computers, none have ever been subject to litigation.").
[102] Abbott, *supra* note 28, at 1080.
[103] Abbott, *supra* note 28, at 1080.
[104] *See* Introduction.
[105] Abbott, *supra* note 28, at 1098.

investment in innovation, but this must be balanced against the social cost of granting a government-sanctioned monopoly that can limit the diffusion of knowledge.[106] This balancing is necessary to achieve the ultimate goal of advancing public welfare.[107]

A. Competitive Advantage in Innovation

First, allowing AI inventorship may put the U.S. patent regime at a competitive advantage relative to its peers.

In the past, the U.S. patent system gained a competitive advantage by allowing man-made organisms to be patentable subject matter.[108] Similarly, allowing for AI inventorship could spur the use and development of inventing-AI. To illustrate this, the USPTO allowed the first transgenic animal, the "Harvard Mouse," to be patented in the wake of *Diamond v. Chakrabarty*, 47 U.S. 303 (1980), which allowed man-made organisms to be patentable subject matter.[109] Biotechnology patents post-*Chakrabarty* were focused on whether the invention constituted patentable subject matter, rather than the morality of the invention.[110] The USPTO left the ethical questions to the legislature and executive branches.[111] The same "Harvard Mouse" patent was submitted to the EPO, but was contested under EPC Article 53 due to ethical concerns.[112] This required the EPO Examining Division "to weigh the suffering of animals and possible risks to the environment on the one hand, and the invention's usefulness to mankind on the other."[113] While the EPO ultimately granted the patent, the codified moral utility requirement opened grounds for litigation and invalidation within the EPC. The EPC's lack of legal certainty and potentially disparate applications of the moral utility doctrine placed the European patent system at a relative disadvantage to the US patent system.[114]

AI inventorship could give the U.S. patent system a similar innovative edge. Where other regimes hesitate to expand inventorship to inventing-AI, the USPTO could challenge the status quo. Just as it had deferred judgments of morality regarding man-made organisms, the USPTO can similarly discount mental acts as an exclusively human capability. Doing so could focus patent law on the "nature of

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[106] Peter S. Menell, et al., INTELLECTUAL PROPERTY IN THE NEW TECHNOLOGICAL AGE: 2019, VOLUME I: PERSPECTIVES, TRADE SECRETS AND PATENTS 27 (2019).
[107] Melzer v. Stein, 347 U.S. 201, 219 (1954).
[108] Benjamin Enerson, *Protecting Society from Patently Offensive Inventions: The Risk of Reviving the Moral Utility Doctrine*, 89 CORNELL L. REV. 685, 694-95 (2004).
[109] U.S. Patent No. 4,736,866 (issued Apr. 12, 1988).
[110] Enerson, *supra* note 108, at 696-98.
[111] Enerson, *supra* note 108, at 696-98; *see* Juicy Whip Inc. v. Orange Bang, Inc., 185 F.3d 1364, 1366 (Fed. Cir. 1999) (refusing to apply the moral utility doctrine to an invention designed to fool the public).
[112] Enerson, *supra* note 108, at 698.
[113] Enerson, *supra* note 108, at 698 (internal quotations omitted).
[114] Enerson, *supra* note 108, at 714.

the invention itself rather than the subjective mental processes by which an invention may have been achieved."[115]

Allowing AI inventorship would remove the legal uncertainty surrounding the validity of inventing-AI created patents, thus incentivizing an underutilized avenue to generate innovative patents. For example, the USPTO has seen increases in recent years in the number of first and second AI-related patent filings due to the large community of AI inventors in the U.S.[116] and allowing for AI inventorship could further fuel this trend.

B. Economic Efficiency

AI inventorship may also increase economic efficiency by lowering the time, effort, and resources needed to innovate. This is an extension of how AI and automation represents the next "industrial revolution."[117]

First, formally requiring patent applications to list a human inventor adds friction to the patenting process. AI inventorship removes the need for a human inventor, potentially lowering the human capital needed to generate novel inventions. Like most automation, inventing-AI is not bound by human limitations and can discover patterns and improvements by considering a greater range of prior art that may extend beyond the typical skilled inventor. With further development, inventing-AI systems can obviate the need for human input and can create patentable subject matter on an economically-scalable level.

Secondly, AI inventorship could shift the process of negotiating and assigning rights to the inventing-AI's invention.[118] Currently, an inventing-AI's invention can only be patented if a human took part in the otherwise autonomous, independent conception process or discovered the invention's importance.[119] This raises questions about which natural person is the inventor and who subsequently owns the patent rights. This is challenging since AI inventions often involve "numerous actors, both overlapping and independent, encompassing software programmers, data and feedback suppliers, trainers, system owners and operators, employers, the public and the government."[120] Furthermore, the decision on who should be listed as the inventor can be challenging when approximately 93% of patents are assigned to organizations rather than individuals.[121] Mechanisms for transfer include employment and work-for-hire agreements, but not all actors

[115] Abbott, *supra* note 28, at 1098.
[116] WORLD INTELLECTUAL PROP. ORG., WIPO TECHNOLOGY TRENDS 2019: ARTIFICIAL INTELLIGENCE 83-84 (2019).
[117] WORLD ECON. FORUM, ARTIFICIAL INTELLIGENCE COLLIDES WITH PATENT LAW 5 (2018).
[118] Shemtov, *supra* note 10, at 30.
[119] *See* Part I § V(B); *see also* FlashPoint, *supra* note 93, at 6.
[120] Shemtov, *supra* note 10, at 30.
[121] Abbott, *supra* note 28, at 1092 n.101.

involved with the use and development of an inventing-AI may be bound to such contracts.

UEI theory dictates that society is be best served by allocating patent rights to the party that can maximize economic efficiency. Economic efficiency is optimized when the party that most values the patent also owns the patent rights, though this varies depending on the party and its respective industry.[122] Given that economic efficiency is a case-by-case analysis, allowing inventorship rights (and subsequent ownership rights that flow from inventorship) to vest in an inventing-AI would encourage interested parties to contract or negotiate for transfer of those rights retrospectively rather than prospectively. Ideally, the party that most values the patent will be the highest bidder capable of commercializing the AI-produced invention.[123]

This can plausibly extend to real world scenarios where a third party designs an inventing-AI, such as IBM's Watson, to be distributed for use by other parties.[124] These parties could use an instance of Watson on their own hardware, which could then be trained and adapted to invent within the desired parameters of a given industry. In this hypothetical, it would be unclear who would claim rights to Watson's invention or how that dispute could be resolved in efficient manner. AI inventorship create possibilities to leverage existing frameworks such as work-for-hire and employment agreements to increase economic efficiency.

Lastly, AI inventorship can make inventing-AI economically viable for companies by reducing the cost to obtain patent rights while ensuring more knowledge is made publicly available. With less money spent on research and development, the market monopoly that comes with patent rights becomes more valuable over other options such as trade secret protection which limits public disclosure and dissemination of knowledge.[125] Such an economic incentive could rapidly increase patent filings and subsequently enrich society's access to new knowledge. Moreover, the U.S. could draw international companies and investors to capitalize on an innovation-friendly patent system. If successful, it could incentivize other patent regimes to follow suit given the U.S.'s dominant position in AI technologies. Increasing patent filings expands the pool of knowledge from which inventors can draw from, thus further accelerating societal and scientific progress already being made by AI technology.

C. Increased Patent Value for Practicing Entities

AI inventorship could also shift the value of patents in the marketplace by enhancing patent value for practicing entities relative to patent assertion entities.

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[122] W. Michael Schuster, *Artificial Intelligence and Patent Ownership*, 75 WASH. & LEE L. REV. 1945, 1950 (2018).
[123] *Id.* at 1986.
[124] Abbott, *supra* note 28, at 1115.
[125] Abbott, *supra* note 28, at 1104.

The complex patent ecosystem consists of two major entities: practicing entities ("PE") and patent-assertion entities ("PAE").[126] PEs are commonly companies that practice their inventions and use patents to maximize their freedom to operate.[127] In contrast, PAEs are "entities [] focused on the enforcement, rather than the active development or commercialization of their patents" and can be further divided into several types such as "large-portfolio companies, small-portfolio companies, and individuals."[128]

Both entities employ two board patent strategies to achieve operating freedom and profitability: a defensive "arm race" strategy and an offensive "marketplace" strategy.[129] The "arms race" strategy involves developing or purchasing a high quantity of patents with less attention paid to quality.[130] The objective is to build a patent arsenal to defend against the risk of patent litigation, neutralize lawsuit threats by competitors, and leverage the patent portfolios to promote cross-licensing while establishing market presence and revenue streams.[131] PEs often adopt a "marketplace" strategy to quickly adapt their patent portfolios to protect against litigation. Conversely, the "arms race" strategy involves offensively asserting large patent portfolios that were initially developed for defensive purposes.[132] This includes generating profit through licensing or organizing company subsidiaries to sue companies in technology areas where the patent owner does not practice.[133] PAEs frequently employ an "arms race" strategy to use their patent portfolio to offensively to sue or threaten to sue practicing companies.[134]

The interplay between PEs and PAEs leads to both entities swinging between "arms race" and "marketplace" strategies, which increases the social cost associated with patent rights by (1) lowering patent quality while (2) increasing the ability of PAEs to hold-up practicing companies from exercising their patent rights.[135] Defensive patenting results in fewer lawsuits, but also has a negative effect of increasing the number of low-quality and unused patents that can lead to patent-hold up.[136]

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[126] Colleen Chien, *From Arms Race to Marketplace: The Complex Patent Ecosystem and its Implications for the Patent System*, 62 HASTINGS L. J. 297, 298 (2010).
[127] *Id.* at 320.
[128] *Id.* at 328.
[129] *See id.* at 320.
[130] *See id.* at 321.
[131] Colleen Chien, *From Arms Race to Marketplace: The Complex Patent Ecosystem and its Implications for the Patent System*, 62 HASTINGS L. J. 297, 299 (2010).
[132] *Id.* at 321.
[133] *Id.* at 342.
[134] *Id.* at 344.
[135] *Id.* at 344.
[136] *Id.* at 336 (Defensive patenting motives "drive the accumulation of large numbers of low-cost patents.").

In theory, AI inventorship could lower the social cost associated with patent rights by financially incentivizing companies to employ inventing-AI to create high quality patents over buying them in the patent marketplace. AI inventorship can promote inventing-AI as a cost-efficient alternative method to amass patents, potentially eliminating the need to purchase patents as part of the "arms race." Moreover, companies may be less likely to dispose of their patents in the patent marketplace for lack of strategy value or use. Conversely, smaller PEs can use inventing-AI to compete with industry giants by first building their own portfolio with lower time and money investments then later generating capital through licensing. Both approaches could reduce low quality patents in the marketplace, effectively limiting an avenue for PAEs to acquire patents for litigating purposes. AI inventorship could shift the patent ecosystem to favor PEs.[137] This can enable them to innovate faster and with more precision within their industry. Public welfare benefits when PEs amass more higher quality patents because they gain greater freedom to operate at lower cost while enriching the patent pool.

Other benefits include engaging in positive cross-licensing or open-source activity with greater speed and efficiency. For example, the semiconductor industry benefited when Cisco amassed a large patent portfolio and cross-licensed it to competitors, which prevented those competitors from blocking Cisco products while generating royalties.[138] Similarly, Sun Microsystems shared its patent portfolio to support open-source development. By placing its patents into the public domain, Sun not only capitalized by creating the industry standard in a new field, but also provided developers with the knowledge and freedom to innovate or create derivative works from its platform.[139] Beyond these activities, patents may also be assigned or sold while retaining the right to sell the patent and sue for infringement, which can also keep the patent off the market and further limit PAE activity.[140]

AI inventorship could more greatly benefit PEs over PAEs in the patent ecosystem, encouraging more socially beneficial patent practices and behaviors over innovation-hindering litigation and hold-ups.

PART III

I. CHALLENGES WITH TRANSFER OF OWNERSHIP

Currently, U.S. patent law grants ownership rights to the inventor absent an assignment. Intellectual property is an alienable personal property right which can

[137] Schuster, *supra* note 122, at 1996 ("Societal costs associated with patent troll litigation are substantial. Activity of this nature cannot proceed, however, unless trolls are able to purchase patents.").
[138] Chien, *supra* note 126, at 321.
[139] Chien, *supra* note 126, at 321.
[140] *See* Schuster, *supra* note 122, at 1997.

be transferred, assigned, licensed, or sold.[141] For patents, initial ownership is vested in: (1) the inventor(s) of the patent; (2) an employer via pre-inventive assignments; or (3) an employer for an employee who was "employed to invent."[142] While ownership may be assigned to the natural person inventor, it may also be assigned to non-natural persons such as a corporation via work-for-hire or assignment contracts.[143]

In the absence of an assignment, the original applicant is presumed to be the owner.[144] Where a patent has multiple owners, each owner may exploit the patent without the consent of the others.[145] The owners of a patent gain the "right to exclude others from making, using, offering for sale, or selling the invention throughout the United States or importing the invention into the United States."[146] Where there is only one inventor, and the inventor has not assigned the patent property, the inventor owns the entire right, title, and interest of the patent property.[147] Thus, if inventing-AI is recognized as an inventor, it would not be able to own the patent rights to the invention absent an assignment.

One solution is extending personhood to include inventing-AI, enabling the system to own property rights like natural and legal persons.

Several countries have suggested or attempted this approach, but with limited success. For example, the European Union ("EU") parliament proposed the possibility of establishing electronic personhood, but ultimately found this approach unwarranted given the current state of AI and largely narrow capabilities of most AI systems.[148] Similarly, residency and citizenship were granted to AI robots in Japan and Saudi Arabia, respectively. However, these were mere "public relation exercises" to support initiatives by the local government. The rights arising from these statuses were not elaborated on.[149] In practice, Estonia made the most stride in recognizing electronic personhood within a limited tort liability context so that citizens could understand who is liable when autonomous vehicles case

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[141] Thomas G. Field, Jr., *IP Basics: Managing Intellectual Property*, Univ. N.H., Franklin Pierce Ctr. For Intell. Prop. 1 (2015) ("IP is intangible, but the parallels to tangible property are many. Everything accurately called 'property' represents alienable, divisible and legally enforceable rights."); *see* MPEP § 301 (2018) (patents under 35 U.S.C. are assigned attributes of personal property).

[142] 37 C.F.R. § 3.73 (2018) (inventor is presumed to be the owner of a patent application unless there is an assignment).

[143] Pearlman, *supra* note 46, at 21.

[144] 37 C.F.R. § 1.42 (2018) (referring to the "applicant" as the inventor).

[145] MPEP § 2137.01 (2018).

[146] 35 U.S.C. § 154.

[147] MPEP § 301 (2018).

[148] *See* Shemtov, *supra* note 10, at 25; *see* Open Letter to the European Commission, Artificial Intelligence and Robotics, http://www.robotics-openletter.eu (last visited Dec. 13, 2020) (challenging proposal by the European Parliament to grant electronic personhood to "smart robots").

[149] Shemtov, *supra* note 10, at 26-27.

accidents or malfunction.[150] However, it is unclear whether the Estonian government will pass more legislation to broaden these rights to parallel those of natural persons.[151] In these examples, the legal burden associated with granting personhood to inventing-AI would outweigh its potential economic and societal benefits.

However, the Patent Act has a statutory provision which could be effectively transfer ownership rights. Rather than granting personhood, the USPTO could recognize inventing-AI as a deceased or legally incapacitated inventor under 35 U.S.C. § 409. Under this statute, a legal representative for a deceased or legally incapacitated inventor can file a patent application on the inventor's behalf.[152] Moreover, the representative can file a statement in lieu of an inventor's oath or declaration.[153] Most importantly, the statute allows for the patent to be issued to the legal representative under certain circumstances.[154]

While this seems like a cumbersome workaround, the statute provides a pre-existing framework from which the USPTO can utilize and adapt. It also creates a solution to the portability of inventing-AI. Inventing-AI can be implemented on a variety of systems depending on the user's need, much like how IBM's Watson is available to numerous developers and users while Watson remains under IBM's ownership.[155] The legally incapacitated inventor framework creates an opportunity for parties involved with the inventing-AI to negotiate and contract for who will represent the inventing-AI on a patent application for a given invention. Drawing upon the UEI theory, the ideal legal representative for the inventing-AI would have the highest economic interest in the invention. The USPTO could reduce friction in this process by looking to U.S. copyright work-for-hire practices under 17 U.S.C. § 101 and enacting a similar provision for patents created by inventing-AI.

II. CHALLENGES WITH THE "PERSON HAVING ORDINARY SKILL IN THE ART" STANDARD

If inventing-AI becomes more prevalent as a result of AI inventorship, the element of novelty, non-obviousness, and enablement may become an issue. These elements are judged according to a person of ordinary skill in the art, who is a hypothetical person presumed to have known the relevant art at the time of the invention.[156] With AI's ability to sort, store, and access vast quantities of knowledge beyond what human capabilities, the hypothetical skilled person may

[150] Shemtov, *supra* note 10, at 28.
[151] Shemtov, *supra* note 10, at 28.
[152] 37 C.F.R. § 1.43 (2018); MPEP § 409.01(a) (2018).
[153] 37 C.F.R. § 1.64 (2018).
[154] *Id.*
[155] Abbott, *supra* note 28, at 1115.
[156] Custom Accessories, Inc. v. Jeffrey-Allan Indus., Inc., 807 F.2d 955, 962 (Fed. Cir. 1986).

become a person equipped with an AI system.[157] Elevating the "person having ordinary skill in the art" ("PHOSITA") standard could greatly affect established areas of patent law that rely on this standard, including novelty, obviousness, and enablement.[158] As a result, patenting could become more difficult because of the elevated standard, thus constricting the ability for human inventors to secure patents.

This issue is relevant whether AI inventorship is adopted or not given the dramatic investment in AI technology.[159] While, AI inventorship may accelerate the pace at which this change is occurring, allowing inventing-AI could encourage more AI disclosure on patent applications. This gives the USPTO and other patent-review agencies an opportunity to factor in the use of AI when using the PHOSITA standard.

III. OTHER CONSEQUENCES

Aside from legal hurdles, scholars have noted that AI inventorship could result in potential negative consequences. First, inventing-AI could result in a dramatic consolidation of intellectual property by large corporations, as these businesses are the ones most likely to have the resources to develop, maintain, and deploy these systems.[160] Secondly, AI inventorship could lead to such a rapid proliferation of patents that companies may be rationally incentivized "to sell the patent for any non-zero sum" on the marketplace, resulting in PAEs having more access to inexpensive patents to assert against PEs.[161] These consequences are merely possibilities, and they would need to be explored in more detail if AI inventorship becomes a reality.

CONCLUSION

The U.S. patent system has the potential to strongly benefit from recognizing inventing-AI as inventors. It would enable the U.S. patent regime to develop a competitive edge among its peers, encourage investment and use of inventing-AI, and shift the patent value towards PEs to encourage behavior that maximizes the social utility of patents. Though the challenges and potential negative consequences casts a shadow on whether AI inventorship is the best avenue to promote the Constitutional purpose behind patent rights, the U.S. may not have a similar prime opportunity to capitalize on a technology that will continue to see growth and controversy in the patent space.

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[157] Susan Y. Tull & Paula E. Miller, *Patenting Artificial Intelligence: Issues of Obviousness, Inventorship, and Patent Eligibility*, 1 J. ROBOTICS, ARTIFICIAL INTELLIGENCE, & L. 313, 320 (2018).
[158] *Id.*
[159] Abood, *supra* note 98.
[160] Abbott, *supra* note 28, at 1119.
[161] Schuster, *supra* note 122, at 1997-98.