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Human to machine innovation: Does legal personhood and inventorship threshold offer any leeway?

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Abstract

Artificial Intelligence (AI) continues to be a powerful tool in the research and development ecosystem. AI computers are invented to assist human invention and also created to invent. Where an AI is created to invent, through self-learning, they can interact with set of data presumably created by humans and as a result, a new patentable invention(s) can emerge. However, where the AI inventors and the resulting inventions sit within the inventorship legal framework, and the theory of legal personhood continues to raise legal and policy questions that challenge some underlying or presumed settled intellectual property law assumptions. One of the contentions has been the implications of the AI machine's autonomous inventions on the legislative and judicially established threshold for patent inventorship and the jurisprudential theory of legal personhood. The judicial decisions in the United States of America (USA), United Kingdom (UK), and Australia in the Device for the Autonomous Bootstrapping of Unified Sentience (DABUS) patent applications have given judicial certainty on whether AI machine inventors qualify as inventors. However, they also reawakened the debate about the need to sustain patent incentives for AI

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innovations. This article draws from the inventorship threshold in the UK and US following the court decisions in the DABUS cases. The judicial decisions of courts and the administrative judgements of national Intellectual Property Offices (IPOs) relating to inventorship as well as the theory of legal personhood, reveal that an AI machine invention can be patent eligible. However, the machine does not satisfy the inventorship criteria and consequently is incapable of being named an inventor. On the other hand, the inventorship requirement of contemporaneous conception and reduction to practice meant that an AI owner/programmer may not satisfy the requirement of inventorship, even though he/she programmed the inventing machine. These decisions and judgements favour an implied situation where autonomous AI inventions could be without named inventors and owners. Consequently, those inventions will automatically form part of prior arts thereby rendering myriads of future human and AI inventions obvious or already existing in the public domain. In contributing to the discourse, this article advances the argument that to optimise the patent system, national IPOs and the courts can rely on 'simultaneous conception and reduction to practice' to recognise the programmer/owner or other relevant stakeholders in AI innovation as the inventor of AI autonomous inventions.

KEYWORDS
AI personhood, artificial intelligence, DABUS, inventorship, patent

1 | INTRODUCTION

In recent times, artificial intelligence (AI) related research and development (R&D) continues to experience exponentialgrowth and arguably, the prospect of patent protection can sigfinicantly contribute to this growth. The World Intellectual Property Organisation (WIPO) AI Patent trends highlight the relationship between AI innovation and the increased role of patent in encouraging AI inventions.[1] As would be seen in the Device for the Autonomous Bootstrapping of Unified Sentience (DABUS) case in this paper, the increasing trend in AI innovation is prompting the naming of AI machines as inventors in patent applications. Policymakers at different levels and scholarly articles have sought to address the intersections between AI and patents and the unique challenges they bring.

A unique concern arises from when an AI machine autonomously generates an invention without or with limited human involvement. The outcome of the invention raises a question of the appropriate person to be recorded as the inventor. Notably, neither national, regional nor international patent legislations expressly

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contemplated AI inventions at the time of drafting. As some of the features of AI are at variance with the requirements of patent eligibility and inventorship,[2] they have generated legal arguments as to who the actual inventor and owner of such invention should be.[3] Consultations at the national,[4] regional,[5] and international levels[6] are happening to integrate the specifics of AI inventions. Several scholarly articles[7] on this issue have continued to address different issues raised by AI innovation.

IP is generally territorial in nature.[8] Consequently, patent eligibility criteria and inventorship threshold is largely regulated at the national level. At the national level where patent protection is sought, every patent application must satisfy the criteria for patent protection as designated in the relevant patent legislation. Lately, national IPOs in the United Kingdom (UK),[9] the United States of America (USA),[10] Australia,[11] and the European Patent Office (EPO)[12] have ruled in the famous DABUS patent applications that AI machines lack the capacity to be named an inventor. These rulings were confirmed by the Courts of Appeal in the UK,[13] the USA,[14] and the full High court in Australia.[15] In the DABUS patent applications, Dr Stephen Thaler the owner of an AI machine called DABUS filed patent applications for the autonomous invention made by DABUS (a machine) in several jurisdictions including the UK, USA, and Australia. Dr Thaler identified DABUS as the actual inventor and identified himself as the rightful owner of the invention by virtue of his ownership of DABUS. The courts independently but similarly held that as the AI machine is not a natural person, it does not qualify as an inventor, because to hold otherwise will be contrary to the intention of the parliament on inventorship.

Courts have relied on the categorisation of a legal person as either a natural or artificial persons to determine what/who qualifies as a person known to law. The DABUS decisions have generated intense debate and in contributing to the debate, this article considers that the decisions of the IPOs and the courts (eventhough jurisprudentially justified) can strike at the incentive for continued AI innovation. Adopting a literal interpretation of inventorship and the application of the legal personhood theory to the DABUS applications may discourage AI innovation especially where patent mechanism plays a significant role in inspiring such inventions. This article assesses the patent law on inventorship in the USA and the UK as well as the theory of legal personhood against the background of the DABUS decisions to argue that as the innovation landscape is progressively moving from human to machine, the patent system as currently constituted, can do with some flexibilities as an instrument of change, in response to rapid technology advancement. This paper proposes that there should be a firm recognition of the role (s) of the owner/programmer of an AI machine and other relevant stakeholders in AI R&D processes as deserving of inventors of AI autonomous inventions. This approach averts a situation where AI autonomous inventions automatically become part of state of prior arts, thereby rendering many future inventions obvious. The IPOs and the courts can, through the patent doctrine of 'simultaneous conception and reduction to practice' recognise the role or contributions of an AI stakeholder to the autonomous invention which can qualify such person as an inventor.

Against this backdrop, this article proceeds in nine parts. The first part provides a primer on AI technology. Afterwards, AI innovation and autonomous AI inventions are explored to provide a contextual background to the relationship between patents and AI inventions. Third, drawing from the US and the UK's patent legal frameworks, the inventorship threshold is explored to extract the position of the law regarding non-human inventors. Subsequently, the legal theory of legal personhood is considered to understand the jurisprudential basis for the non-recognition of the AI machine as inventors. This is followed by the application of the law on inventorship and the legal personality principles drawing from the DABUS decisions in the UK, USA, Australia, and the EPO. Thereafter, relying on the doctrine of simultaneous conception and reduction to practice, the AI stakeholders as possible inventors of AI inventions are considered to demonstrate how the human actors can satisfy the requirements of conception and reduction to practice to qualify as inventors of AI autonomous inventions. Thereafter, the justifications for awarding inventorship on an AI stakeholder(s) is considered and then the conclusion.

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1.1 | Artificial intelligence technology: An overview

The literal implication of 'Artificial' denotes made by human and not by nature.[16] A definition of intelligence adopted by 52 science experts described intelligence as '…a very general mental capability that, among other things, involves the ability to reason, plan, solve problems, think abstractly, comprehend complex ideas, learn quickly and learn from experience'.[17] From the definition, it seems that intelligence is commonly associated with human beings as rational beings. Machine intelligence would no doubt differ from human or natural intelligence[18] because it is artificial or made by human.

Software engineers attempt to use human-like reasoning to create and programme machines to interact intelligently with data sets.[19] AI machines are creative, often referred to as intelligent[20] and they use algorithms that acquire human-like capabilities like vision, speech and navigation[21] to understand and mimic human intelligence.[22] Theyare algorithms or machines that are capable of completing tasks that would otherwise require human cognition.[23] They have self-learning abilities and often trained to emulate human brains,[24] thereby making them capable of possibly the same level of invention and creativity as any individual.[25] Inventing-AI, that is the AI that is created to invent, take up substantive role in the inventive process by conducting pattern recognition and automating data analysis.[26]

An inventing AI uses machine learning that 'involves building and adapting computational models' that teach computers how to learn and act without being explicitly programmed to do so.[27] They use artificial neural networks (ANNs) which are digital embodiments that simulate the human brain's 'fundamental mechanisms responsible for idea formation', to enable AI to generate new information and to adapt to novel scenarios that are short of further human input.[28] With the ANN, it becomes possible that, without additional human coding, an AI can adapt and undergo a self-assembling process by changing how its ANNs communicate with each other as the computer engages with programmed data set.[29]

Like the biological brains, the ANNs as binary switches simulate neurons[30] to process signals.[31] ANNs are trained by the owner/programmer to recognise patterns and differences in the data set.[32] In some cases, ANN can be supervised learning, where data is labelled and categorised against unsupervised learning where data is unlabelled, and the ANN is expected to interpret the data autonomously.[33]

Stephen Thaler's 'Creative Machine' presents a good example of ANN that mimics the thalamo-cortical loop of the human brain.[34] As reported, the cortex generates streams of output[35] without additional human input. According to Abbot, such genetic algorithm can independently create new inventions because it is programmed to copy the simple process of human 'mutation, sexual recombination, and natural selection' to generate results and achieve machine intelligence.[36]

1.2 | AI autonomous inventions

Remarkably, AI has not achieved the complete range of human-level cognitive, creative, and emotional intelligence across all tasks.[37] It is currently transitioning from 'artificial narrow intelligence' (ANI) ('weak AI' or 'narrow AI') to 'artificial general intelligence' (AGI or 'strong AI') and artificial superintelligence (ASI) where complete human cognition can be possible.[38] At the ASI level, it is expected that AI will radically outperform the best human mind in science, wisdom, and social skills.[39] While some optimism has been expressed that computers will achieve human intelligence in the future,[40] other experts shared the view that achieving human capabilities or intelligence is an over valuation of actual capabilities of even the most advanced AI.[41]

Despite myriad of things an AI can do, ANI lacks consciousness, sentience, human emotions and general human intelligence.[42] Their operations are still within a predetermined and defined range[43] because they are still narrow and specific in performing their functions.[44] As described by Ryan Abbot, Watson for Genomics can analyse a genome and provide a treatment plan, however, it is unable to respond to some open-ended patient queries about

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their symptoms. Consequently, Watson can only provide solution to the problems it is programmed to resolve.[45] AI machines are currently in ANI stage, even though they perform intelligent tasks, they are still considered weak, for lacking full human intelligence.[46]

AI machines largely rely on human involvement to function, and this collaboration will continue until AI machines can operate at the level of human capability or AGI and ASI where they can examine themselves and modify their own behaviour and code[47] without human imputed data. Incidentally, this has not happened in practice. So far, the focus has been to build computers that can mimic human thinking and learn from the programmed data set as opposed to the computers that can think independently and rationally.[48]

These creative computers have been described as inherently possessing the following features that enable artificial creativity: innovative or creative, independent, autonomous operation, rational intelligence, evolving and cable of learning, efficient, accurate, goal-oriented and capable of processing free choices.[49] As further clarified by the European Union (EU) Parliament, smart AI machines that are capable of generating autonomous inventions possess the following features: they acquire autonomy through sensors, they have the ability to self-learn from experience and data interaction, and with minor physical support and the absence of life in the biological sense.[50] The EU Parliament further identified an autonomous action of an AI machine as '…the ability to make decisions and implement them in the outside world, independently of external control or influence; the autonomy is of a purely technological nature and its degree depends on how sophisticated a robot's interaction with its environment has been designed to be'.[51] The autonomy feature enables the AI to act autonomously and functionally deciding for itself how to conclude a human given or devised task.[52]

There are spectrums to AI's involvements with innovation. AI can be used to assist human invention[53] or can act autonomously.[54] Computer assisted invention requires some degree of human input and guidance to arrive at an expected outcome.[55] The inventor uses designs, services, computer software, and or programmes to facilitate the creation of an original idea.[56] Autonomous invention results from the ability of the computer to conceive and generate inventions that are independent of human intervention or guidance.[57] As a special feature, this invention is pressumed to lack human inventive element that can generate technological advancements that are ahead of the capacity of the most innovative human engineers.[58]

To clarify, autonomous in this sense does not mean that the AI is functioning without any form human involvement. The human involvement is to the extent of providing the instructions and the data leading to an invention[59] without further human involvement beyond providing the data. In fact, Ravid et al. identified 10 stakeholders with varying levels of involvement in AI innovation and autonomous invention. The following categories of persons and institutions were identified, software programmer (who can also double as the owner and the trainer of the AI), the data suppliers, trainers/feedback supplier, owner(s) of the AI system, operators of the system, the public, the government, the investor, and the AI itself.[60] Remarkedly, it is thought that the roles of AI programmer, owner, the trainer and the operators stand out in the R&D processes.

Plotkin succinctly captured the extent of human involvement in AI autonomous invention. He noted that an individual seeking to invent with a machine learning software will first identify and explain a definite problem and the constraints or the challenges for a computer to arrive at the desired solution, without the traditional requirements of human involvement.[61] The problems are usually posed to the machine in a language the computer understands for the computer to output the invention.[62]

While mimicking human intelligence, interacting with programmed data set, and engaging in self-learning, AI can autonomously invent an idea that might be eligible for patent protection.[63] In an stance where patent protection for such invention is sought by the AI owner or programmer for the AI inventor, it raises a question about whether the AI machine inventor qualifies to be named the inventor under patent law or whether alternatively, the AI owner or programmer can be named as such.

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1.3 | Patent and autonomous AI inventions

One of the cores of the patent mechanism is the promise of incentives for continued innovation[64] and R&D investment that could guarantee inventors reasonable certainty of return on the outcome of the invention.[65] The value of the patent in promoting and appropriating innovation continues to increase, and in some cases, the size of a firm's patent portfolio can indicate a positive perception of its interest in R&D.[66]

As already highlighted, AI machines in some cases are invented and programmed to engage in further innovation processes. Human inventors are seen to use AI-based tools in innovations that would have been impossible with only human ingenuity.[67] The AI may be trained to independently interact and learn from a data set[68] to autonomously generate an invention. The resulting invention could have been anticipated or not anticipated by the owner and/or the programmer of the AI.[69] The programmer may not have thought about the idea before they were conceived by the AI and might find the invention quite surprising.[70] This is possible due to the unpredictable feature of AI. It can engage in the activities that its original owners may not have planned.[71] The AI owner/programmer may seek patent protection for the resulting invention where the invention is satisfies the criteria for patent protection.[72]

The specific features of AI as identified by the EU Parliament and Ravid et al., raise questions about their nature and how they can be categorised in terms of legal personhood, and whether a new personality can be created for them.[73] It also raises the question of whether the AI machine inventor qualifies as an inventor. Where it happens that the answer to the later question is in the negative, does the AI owner/programmer or any other relevant stakeholder who designed the machine and the data, works closely with the AI machine, and instructs it, qualifies as the inventor of the resulting invention? To determine the status of the AI machines and the owner/programmer(s) as sole or joint inventor, it is important to examine the legal framework of inventorship to determine the legal parameters for patent protection and inventorship in the US and the UK.

1.4 | Patent criteria and inventorship threshold

1.4.1 | The UK

Section 1(1) a-c of the UK Patent Act, 1977 requires that an invention must be new, involve an inventive step, and be capable of industrial application before it can be eligible for patent protection. Such novel invention should be such that does not already form part of the state of the art or has not been made available to the public or known before the invention.[74] The invention must involve inventive steps and non obvious to a person skilled in the art.[75] Industrial application on the other hand requires that such invention can be made or used in any kind of industry.[76]

Sections 7 and 13 of the UK Patent Act, 1977 recognise the right to apply for a patent. Section 7(1-2) permits 'any person' to make a patent application either alone or jointly and the patent shall be granted to the inventor or joint inventors. Section 13(1) provides that an inventor or joint inventors of an invention shall have the right to be mentioned in any patent granted for the invention. Section 13(2) requires that an applicant for a patent shall file with the IPO a statement that identifies the inventor(s) and where the applicant is not the sole or joint inventor, how the right to file for a patent is derived should be indicated. Failure to satisfy this requirement, the application shall be taken to be withdrawn.[77]

In determining inventorship, section 7(3) requires that an inventor or joint inventor must be the 'actual deviser' of the invention. Sections 3.01–3.38 of the UK Patent Formalities Manual (updated in June 2022)[78] reveals that the right to the grant of patent belongs 'mainly' to the inventor who 'devised' the invention. However, the right can pass to a legal entity by a deed of assignment, by inheritance following the death of the inventor, by a contract of employment, and by acquisition following the bankruptcy of the inventor. Section 3.02 further requires that an

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applicant to patent must file a form 7 which should detail the name of the inventor(s) and state how they derived the right to the grant of the patent.

In interpreting the actual deviser of an invention, the House of Lords in the case of *Yeda Research & Development Co Ltd v Rhone-Poulenc Rorer*[79] held that the only relevant question is 'who came up with the inventive concept?' Accordingly, only the person who came up with the inventive steps is regarded as the inventor. Lord Hoffman stated that:

> The inventor is defined in section 7(3) as "the actual deviser of the invention". The word "actual" denotes a contrast with a deemed or pretended deviser of the invention; it means, as Laddie J said in *University of Southampton's Applications* [2005] RPC 220, 234, the *natural person* who "came up with the inventive concept." It is not enough that someone contributed to the claims, because they may include non-patentable integers derived from prior art:. As Laddie J said in the *University of Southampton* case, the "contribution must be to the formulation of the inventive concept". Deciding upon inventorship will therefore involve assessing the evidence adduced by the parties as to the nature of the inventive concept and who contributed to it. In some cases, this may be quite complex because the inventive concept is a relationship of discontinuity between the claimed invention and the prior art. Inventors themselves will often not know exactly where it lies.[80]

Inventive concept implies the core of an invention which is the new technical insight an invention portrays and as would be perceived by a person skilled in the art.[81] Consequently, any natural person who takes part in a R&D process can prove or demonstrate inventive concept of a resulting invention will be entitled to inventorship.

1.4.2 | The USA

The US Patent Law 35 U.S.C 101 patent eligibility criteria are in all fours with the UK's requirements of novelty, inventiveness, and industrial application.[82] There is a further requirement that a patent application can only be made by the 'inventor'.[83] The application shall include specifications, drawings, an oath or declarations as well as the name of the inventor.[84] The individual(s) named as the inventor or joint inventor shall execute an oath or declaration concerning the application. The oath statement requires that the declarant believes himself to be the original inventor or original joint inventor of the invention. In place of the declaration on oath, a substitute statement is allowed where an individual is unable to file the declaration because of death, legal incapacity, or cannot be found after diligent efforts were made.[85]

The award of patent only goes to the true and only inventor. Drawing from case laws, true and only inventors are required to demonstrate evidence of 'conception of the idea' and the 'reduction of the idea to practice'.[86] According to the US Court of Appeal for the Federal Circuit in *Solvay S.A V Honeywell International*,[87] conception is the formation in the mind of the inventor, of a definite and permanent idea of a complete and operative invention. On the other hand, reduction to practice happens when the claimed invention works for its intended purpose, or when the application is filed with sufficient disclosure.[88]

Conception and reduction of ideas are the core of inventorship. In *Burroughs Wellcome Co. v. Bar Labs*[89] the court held that the 'definite and permanent' condition requires that an ordinary skill would be necessary to reduce the invention to practice without further extensive research or experimentation.

The scope of conception covers both the idea to be accomplished and the means of accomplishing the idea. Consequently, a person who merely suggests the idea cannot qualify as either an inventor or a co-inventor.[90] To qualify as an inventor, the US court in *Fiers V Revel*[91] noted that a person must make contributions to the conception (which is the mental aspect of inventing) of the invention in question. The inventor must prove that he/she made and understood the claimed inventive steps of the subject matter.[92]

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Against the background of the mental element requirement in conception, the US Federal Circuit Court held that only natural persons can be inventors.[93] The court further held '…that people conceive, not companies' because companies have an artificial personality in law.[94] In *University of Utah v Max Planck Gesellschaft Zur*,[95] the court reiterated that inventors must be natural persons, not corporations or sovereign states because they cannot perform the mental acts that are required in R&D processes.[96] According to the court, a state has no sovereign interest in inventorship because inventors are individuals that conceive the invention. Consequently, non-natural persons cannot be inventors.[97]

So far, judicial precedence in the UK and the US supports human inventorship. Where an invention satisfies the criteria for patent protection, the law requires that the *inventor* who can also be the owner shall have the right to apply and be granted the right over the patent. It follows that a patent can only be granted to the rightful inventor(s) and owner(s) who meet the criteria for patent inventorship to wit: actual deviser, conception, reduction of idea to practice, and a natural personality.

The highlighted features raise the question of whether the US and UK patent legislations envisaged AI machine as possible inventors? Could the judicial interpretations of inventorship be inspired by the jurisprudence of legal personhood?[98] Is it possible that machines come within the meaning of a person to qualify as an actual deviser or capable of demonstrating conception and reduction to practice?

1.5 | AI machines as legal persons

Legal personhood is premised on the assumption that all legal relations take place between natural and artificial persons like companies.[99] Natural persons are human beings which bear rights and duties, whilst artificial persons refer to corporations and public bodies.[100] In general, legal personality presupposes that a person can obtain rights and possess duties within a legal system and both natural and artificial persons have been ascribed these abilities.[101]

Renewed interest in the theory of legal personhood has emerged following the emergence of AI, which now challenges the known natural and artificial categorisations of persons.[102] This has therefore prompted the attempts by scholars[103] to deconstruct the natural and artificial divide in the law of persons[104] towards the possibility of accommodating AI.

Can inventive AI machines be classified as legal persons? The theory of legal personhood implies the existence of rights, ownership, legal competencies, and the ability to bear responsibilities.[105] The status of a person in law is ascribed to 'beings' that are designated by the law as rights-holders.[106] As described by Smith, a legal person is subject to rights and duties. Consequently, conferring legal rights or imposing legal duties would imply conferring legal personality on a person.[107] These features would imply that a person in law acquires the ability to enter into a legal relationship and not merely be an object of a legal relationship.[108] Applying this to AI means that an AI machine is expected to have legal rights, duties, and the ability to enter into contractual relationships.

In adding another attribute to the right and duties in legal personality, Gray argued that without the will to exercise those rights, there can be no right, and therefore no legal personality. He consequently argued that for a right to be given effect, there must be an exercise of will by the owner of the right.[109]

Kurki has considered that if some AI machines have significant value and can autonomously execute instructions, they should claim rights and we can owe duties to them.[110] Kurki's view leaves an open-ended question of the type of duties we can owe to AI machine and the type of duties AI machines owe to the public. As portrayed earlier, linking AI machines to legal personality can be quite dicey since AI is still on a transition to full autonomy and superintelligence.[111] AI development has not fully transited to a complete range of human-level cognitive, creative, and emotional intelligence across all tasks.[112] In fact, such full transition might not be possible as the strong AI that is portrayed as having human-like abilities to cognitively reason and be morally culpable for its actions, currently exists in science fiction.[113]

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Interesting legal questions emerge from the inventorship threshold and legal personality. Does it follow from the fact that an AI machine can autonomously generate an invention it should qualify as a legal person? If so, what category of legal person does it belong to? A natural or artificial person? Can creative AI machines have rights, duties, capacities, and independent will?

Notably, the quest to recognise AI as a person in law is anchored on two reasons. First, is to ensure there is someone to hold answerable for the wrongs committed by the machine. Second is to ensure reward when things go right.[114] Incidentally, these reasons, make it more difficult to confer personality on a machine that does not possess the ability to recompense for the wrongs they occasion or to actively exploit the benefits of owning a patent.

It has been argued that as potential natural persons, creative AI machines should ideally exercise recognised human rights like right to freedom of movement, liberty, life, and the right to vote in an election and be voted for.[115] The justification for this argument is still unknown and unclear because AI machines are clearly nonhuman. It is further highlighted that AI machines will ideally differ in sophistication, and this will significantly determine the level of human-like cognition they operate at. Incidentally, human-like cognition differs from human cognition strictly speaking. It is possible that future AI innovation can achieve the envisaged level of human cognition and sophistication to equalise with human intelligence and cognition. However, until then, AI remains a nonhuman, hence, does not qualify as a natural person.

The argument for the recognition of AI as a person draws from an analogy to corporations as artificial persons with a legal personality.[116] The concern is that corporations lack the human intelligence and will, yet they hold constitutional rights and duties.[117] The argument is based on the principle of corporate ownership that permits nonhuman legal entities to retain responsibility for legal dispositions and to hold rights (including IP rights).[118] The comparison argument is further influenced by the idea that AI will get to a point of indistinguishability from human. Consequently, they should have a comparable status to natural persons.[119] Remarkedly, the theory of corporate responsibility clearly differs from the creative features of AI and the ability to invent. It is not in doubt that corporations function through humans and in the event of corporate wrongs and fraud, the question of the actors to hold liable does not arise as they are clearly identifiable.

Clearly, natural persons possess qualities and human markers like imprisonment, birth, death, and reproductive rights.[120] Expanding the abilities of natural persons, Britta Van Beers identified five traditional markers of natural persons as follows: natural persons belong to the human species, natural personality begins from birth; the natural personality ends with death, natural persons are products of a sexual relationship between the opposite sex, and natural persons are either male or female.[121] Notably, this last maker can be contentious because of gender classifications beyond male and female. In objecting against recognising constitutional rights for AI, Solum identified three objections. First, only natural persons should be given the rights of constitutional personhood. Second, AI lacks some critical component of personhood like consciousness, intentionality, soul, or feelings. Third, since AI machines are human creations, they remain the property of the owner.[122] On the other hand, where artificial personality is envisaged as corporations and public bodies, this would imply the right to form contracts, own properties, and use the court system to sue and be sued.[123]

Bearing these rights, duties, capacity, will, and other markers of natural and artificial persons in mind, if an AI machine is to be regarded as either a natural or artificial person, it should be able to exercise these qualities. The point has been made earlier that AI is not a natural person, consequently the recognition as a natural person is out of consideration. Watson an IBM's creative machine presents a good example. In 2011, Watson defeated other human participants in the Jeopardy game show.[124] Watson was described as capable of computational creativity that can create millions of ideas from several possibilities and it could predict the best answer.[125] Watson used logical deduction that draws from massive databases that contain accumulated human knowledge and expertise, to mimic human creativity.[126] While interacting with the set of data, Watson (even though it is not modelled after the human brain) can generate new inventions.[127] Is it arguable that these abilities confer natural status to WATSON?

AI responsibility would imply that AI machines should be capable of being held morally and criminally responsible for their actions and inactions. As earlier highlighted, the US patentapplication requires prospective

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inventors to execute a Declaration of oath that he/she is the inventor. Ideally, statements on oath carries a criminal liability where the statements are false or untrue. If an AI can execute a Declaration of oath, it follows that it can be held criminally liable for perjury where the declared information is false.[128]

Beyond the IP issues, there are legal questions like civil liabilities arising from negligent driving of AI self-driving cars and medical diagnostic machines.[129] This means that the acceptance of AI machine as a natural persons would mean a wholistic overhaul of a country's legal framework or policy AI features have rattled.

The increasing involvement of AI machines in the innovation landscape and the issue they raise have prompted a strategic move to integrate AI within a legal framework. At the regional level, adopting a public interest approach, the EU parliament has recommended creating a specific legal status for robots. The Parliament has considered that the most sophisticated autonomous AI machines or robots can be conferred the status of electronic persons that will be capable of taking responsibilities for any damage they may cause. The electronic personality is also applied to cases where they make autonomous decisions or independently interact with third parties.[130] Incidentally, the features of this new status and the scope of rights the new personality will encompass remain unclear.[131] Clearly, the parliament's recommendation is underpinned by the need to provide means for victims of harms caused by AI machines to get redress. Arguably, the electronic personality will not change the nature of AI as incapable of being held directly liable for criminal and civil wrongs arising from its operation, without the human characters like the owner, programmer, or any other person with proprietary interests.

Clearly, algorithmic processes underlying computer are not traditional legal persons, whether natural or artificial. Even though they can make autonomous decisions, they are understood to have a different nature from the acts of natural or artificial persons[132] because they are designed to have such nature.

1.6 | The application of the laws and the emerging legal issues for AI inventors

Drawing from the analysis so far, a strict and literal application of inventorship threshold means that AI machines have no mind[133] for conception of ideas to take place and this means that the requirement of conception is not satisfied. Consequently, the machine by legal definition and judicial interpretation does not qualify as an inventor because without conception, there will be no invention.[134]

The possible outcome is that, for patent purposes, inventions that are generated by automation have no inventor but are merely a product of physical circumstances because of AI machination.[135] Since they were not conceived by human, they are ineligible for patent protection,[136] even where the inventions satisfy the criteria for patent protection. Consequently, such inventions will default into the public domain to form part of prior arts,[137] without maximising the cost of R&D through patent right.

To claim inventorship, the person must demonstrate evidence of contribution to the conception of the ideas[138] or that he/she devised the inventive concept. Drawing from the highlighted case laws on inventorship,[139] the scope of conception covers contributions towards the ideas, the means of accomplishing it, the ability to prove that he/she made the invention to have the features that compose the inventive steps or that he/she was responsible for the invention or the inventive concept and or the contributions that were made to the heart of the invention. Clearly, an AI machine cannot demonstrate or prove contributions (since it lacks the ability to communicate), except where possible, through the AI owner/programmer or the user who understands the invention.

The ability to demonstrate conception and contribution could legally explain the attribution to a natural person in the highlighted UK and US inventorship legal framework. In specific terms, the UK Patent formalities Manual (as updated in October 2019) in section 3.05 expressly excluded AI inventors. It provides:

> Where the stated inventor is an 'AI Inventor', the Formalities Examiner requests a replacement F7. An AI Inventor is not acceptable as this does not identify 'a person' which is required by law. The consequence of failing to supply this is that the application is taken as withdrawn under s.13(2)[140]

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Sections 3.08 and 3.09 further require that a patent applicant must state how the right to the patent is derived and that a statement of the derivation of right for that purpose must also be stated in Form 7 satisfying the requirements of section 13(2) of the Patent Act 1977. The statement must indicate how the applicant derived the right to the grant of the patent which shall be well particularised. Even if AI was accepted as a legal person, it would be arguably difficult to document a detailed and step-by-step inventive process for an AI led invention.

In recent times, the UK and the US as well as in Australia's, inventorship legal framework was judicially tested in the DABUS patent applicationagainst the background of whether an AI inventor qualifies as an inventor, under the patent law.

1.7 | The DABUS applications

1.7.1 | The UK

In September 2021, the UK Court of appeal in *Stephen Thaler V Comptroller General of Patents Trademarks and Designs*[141] addressed the issue of whether an AI qualifies as an inventor. In this case, Stephen Thaler a Doctor of Physics created DABUS. DABUS is an AI machine that uses ANN system to mimic the creative process of a human brain. It converts the information it has learnt into ideas and then uses the accumulated experience to judge its merit.[142] The invention was about two inventions: a food container, the devises, and methods for attracting enhanced attention. DABUS invented a beverage container and a flashing device that can be used for search and rescue.[143] In filing for a patent over the inventions, Dr Thaler named DABUS machine as the inventor as required under s.7(3) of the UK Patent Act and based on the obligation under s.13(2)(a) of the UK Patent Act, he made a statement identifying the person he believed to be the inventor and how he, Dr Thaler derived the right to be granted the owner of the patent under s.13(2)(b).

The patent application was first filed at the UK Intellectual Property Office (UKIPO).[144] Some of the issues for determination in UKIPO were: whether the UK Patent Act recognises a nonhuman inventor and whether the right to the grant of a patent that rest primarily on the actual deviser of the inventor, can be transferred to the applicant Dr Thaler? In other words, is Dr Thaler as the owner of DABUS entitled to apply for a patent in preference to DABUS? The UKIPO determined that a nonnatural person does not qualify as an inventor because of the provisions of the law on inventorship and that Dr Thaler has not complied with the requirement of s.13(2)(a)(b), hence, the patent application was deemed withdrawn. Overall, the UKIPO concluded that DABUS is not a person known to the law, as such, it is not envisaged by ss.7 and 13 of the Act and consequently cannot apply for a patent. Following the refusal of the UKIPO, an appeal was made to the Court of Appeal.

At the Court of Appeal, one of the grounds of appeal was whether the 1977 Patent Act requires that an inventor must be a person, the meaning of s.13 of the Patent Act, and how it works. On whether the 1977 Act requires an inventor to be a natural person, the court noted that the Act was premised on the assumption that an inventor is a person because s.7(2)(c) refers to 'person or person(s) and s.13 of the Act requires an applicant to identify the "person or persons whom he believes to be an inventor or inventors"'.[145] The court further held that DABUS is not the actual deviser because only a 'person' who devised the invention should be named as such.[146] The court noted that:

> Machines are not persons. The fact that machines can now create inventions, which is what Dr Thaler says happened in this case, would mean that machines are inventors within the meaning of the Act. Assuming the machine is the entity which actually created these inventions, it has no right to be mentioned as the inventor…[147]

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1.7.2 | European patent office

Like the UKIPO, the DABUS's EP 18275163 and EP 18275174 patent applications at the European Patent Office (EPO) were rejected in 2019 on similar grounds. The application was rejected for naming DABUS as the inventor as opposed to a human being[148] under Article 81 and Rule 19(1) of the European Patent Convention (EPC). Article 81 requires that European patent applications shall designate the inventor and where the applicant is not the inventor or not the sole inventor, he shall make a statement indicating the origin of the right to the European patent. Rule 19(1) of the EPC requires that the designation of an inventor shall state the family name, given names, and full address of the inventor.

The EPO rejected the argument that Rule 19(1) EPC does not require that the inventor must be a human being to qualify as an inventor. The EPO noted that the application designating machine as the inventor does not meet the requirements under the EPC which requires that an inventor must be a human being. The EPO noted that the requirement of a given name in Rule 19 refers to the names of natural persons because Article 58 EPC provides for natural persons and bodies that are equivalent to a legal person. The EPO held that:

> AI systems or machines have at present no rights because they have no legal personality comparable to natural or legal persons. Legal personality is assigned to a natural person as a consequence of their being human, and to a legal person based on a legal fiction. Where nonnatural persons are concerned, legal personality is only given on the basis of legal fictions. These legal fictions are either directly created by legislation or developed through consistent jurisprudence. In the case of AI inventors, there is no legislation or jurisprudence establishing such a fiction. It follows that AI system or machines cannot have rights that come from being an inventor such as the right to be mentioned as the inventor or to be designated as an inventor in patent application.[149]

Upon further appeal to the Board of Appeal of the EPO by Dr Thaler in case number J 008/20, the Board reaffirmed the ruling of the EPO and dismissed the appeal. It found that the EPC did not provide for non-persons, but only for legal or natural persons as applicant, inventor or in any other role in the patent grant proceedings. It further held that in matters of inventorship, in the EPC, reference was made only to natural persons. Dr Stephen's statement that he derived the ownership of the patent for being the owner of DABUS is inconsistent with Art.81 EPC because he could not be considered the successor in title of an AI system.[150]

1.7.3 | The United States of America

Similarly, The DABUS application was made to the United States Patent and Trademark Office (USPTO) in 2020.[151] The USPTO ruled that an AI system cannot be named an inventor. The USPTO relied on the previous decisions in *University of Utah V Max Planck-Gesellschaft*[152] and *Beech Aircraft Corp. V Edo Corp*[153] to hold that AI machines do not qualify as inventors. The USPTO ruled that the application does not comply with 35 USC 115(a) since the application named DABUS as the inventor and that the current statutory provisions of the US, case laws and the USPTO regulations and rules, limit inventorship to only natural persons.[154]

In 2021, Dr Stephen challenged the ruling of the USPTO, in the Federal Circuit Court in a suit between Stephen Thaler V Andrew Hirshefeld[155] and subsequently to the US court of Appeal for the Federal Circuit in Stephen Thaler V Vidal in 2022[156] The court held that Congress's use of the word 'individual' in the Patent Act supports the conclusion that an 'inventor' must be a natural person. The court continued that the requirement to execute the oath or the declaration in a patent application must include a statement that 'such individual believes himself or herself to be the original inventor or an original joint inventor of a claimed invention in the application'. Consequently, the ordinary meaning of the word individual as contained in the US Patent law only refers to natural persons to the exclusion of AI machines. Still relying on the cases of

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Max Planck and *Beech Aircraft* (supra), the court reaffirmed that 'inventors must be natural persons' and 'only natural persons can be inventors'.[157] The Supreme court reasoned that when used in statutes, the word 'individual' refers to human beings unless there are 'some indications that Congress intended a different reading'. The court noted that nothing in the Patent Act indicates that the Congress intended to deviate from the default meaning of the word 'individual'. Consequently, the court concluded that, to the contrary, the rest of the Patent Act supports the conclusion that 'individual' in the Act refers to human beings.[158]

1.7.4 | Australia

A further attempt was made by Dr Thaler to file a patent application for DABUS in Australia. The Comptroller of patents refused the application because of nonrecognition of the AI machine as an inventor in the Australian Patent Act.[159] The Deputy Commissioner ruled that an AI system cannot be an inventor as s.15(1) of the Patent Act does not admit to a situation where an inventor would be the AI machine. Consequently, the AI machine can invent something that satisfies the criteria for patentability, but the invention will not be patentable because the Act requires a human inventor.[160] In challenging the decision, Dr Stephen Thaler applied for judicial review in the Federal Court of Australia in *Stephen Thaler V Commissioner of Patents*.[161] He argued that the Patent Act does not preclude an AI system from being recognised as an inventor. The federal court rejected the Deputy Commissioner's decisions and held that an AI system can be an inventor for the purposes of the Act. The court reasoned that to hold otherwise will not reflect the reality in terms of many otherwise patentable inventions where it cannot sensibly be said that a human is the inventor.[162]

Incidentally, the victory of AI machines as inventors in Australia was short-lived as a full panel of five justices of the Australian Federal Circuit court in April 2022 overturned the decision in Stephen Thaler (supra) in the case of Commissioner of Patents V Thaler.[163] The court held that 'only a natural person can be an inventor for the purpose of the Patent Act and Regulations'.[164] Given this position, the court did not proceed to determine the entitlement or ownership issue because a natural person inventor must be identified before ownership can be determined under ss.15(1)b)-(d) of the Patent Act and Regulation.[165]

Across the US, UK, Australia, and the EPO jurisdictions, it is seen that a literal interpretation and the application of the law and legal personhood do not recognise the AI machine as an inventor because it does not satisfy the natural person requirement of inventorship. It is clearly seen that nonhumans can create intellectual property; however, they do not have the required legal personality to claim those rights under the Patent laws and the theory of legal personhood.

So far, the issue as seen is not whether an AI invention is eligible for patent protection (in terms of the criteria for patentability), but whether the named inventor has the legally recognised personality to be named as such. In the absence of a named inventor, it becomes problematic or impossible to determine the rightful owner of the invention in question. However, it is apparent that AI machines do not operate alone but in collaboration with the owner(s) and/or programmer(s)[166] of the machine who created and designed the data set the AI machine interacts with. This raises the question of the possibility that a natural person can claim inventorship of an AI generated invention. For instance, the AI owner/programmer can qualify as the inventor of the autonomous invention provided, he/she can demonstrate contribution to the conception of the invention or the inventive concept as in the US and the UK. This paper will now consider the stakeholders in the AI innovation ecosystem to determine the possibility of being named inventors of AI autonomous invention to sustain patent incentive.

1.8 | Recognising the role of stakeholders or multiplayers in AI innovation

The patent reward theory is believed to incentivise innovative activities in exchange for a government's exclusive or monopoly right to exploit the products or processes embodying an inventions.[167] Even though patents have been

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argued to restrain trade and access to patented inventions, it is tolerated because of the expectation that by imposing exclusivity costs in the short run, it will result to a long run benefit of greater social welfare.[168] The cost of patent to the society can be normatively justified where the benefits of increased innovation outweigh the cost on society.[169]

Specifically linked to this discourse is the theory of invention-motivation which explains the most popular economic justification for patent protection. Patent exclusive right motivates increased investment in new inventions because it presents a market scenario or advantage that offers the optimal mechanism for the recovery of R&D expenditures.[170] It provides a safeguard against the use of an invention by a third party to avoid extra R&D expenditures. Consequently, the absence of an exclusive right advantage may discourage patent owners from further R&D investment.[171] Where patent no longer provides the expected incentives, the justification for the cost becomes doubtful.[172] Like other laws, patent law should be flexible and can be adapted to a wide range of new technologies[173] with minor doctrinal adjustments that are within the policy lever of the courts and the patent offices.[174]

The trend in technology advancement and machine inventions in the innovation landscape, sees a combination of human and computer efforts in R&D processes, and this cannot be overlooked. An alliance between legal and nonlegal entities is evident as machines cannot operate in vacuum,[175] until the era of super intelligent computers is achieved. Incidentally, the possibility remains a fiction. Drawing from the highlighted judicial and legislative positions of the UK, US, and Australian courts and the EPO, only the human entity can qualify as an inventor. The question is whether the decisions provide an optimal patent mechanism? Does it jeopardise the incentive for continued AI innovation?

Proposals have emerged on the best approach to maximise the patent system regarding AI inventorship. Abbot argued that creative computers should be statutorily recognised as inventors.[176] In advancing this argument, Abbot posited that such recognition would boast new scientific advances in the AI industry.[177] To sustain the patent benefits, he recommended a dynamic interpretation of the law to allow computer inventorship since they do not upset the existing patent policy.[178] Incidentally, as already highlighted, the judicial interpretations of inventorship in DABUS did not support Abbot's line of reasoning. For instance, the Australian full court expressly disapproved of approaching statutory construction by reference to desirable policy[179] given that whether the AI machine qualifies as an inventor remains a question of law.[180] In other words, the features of AI machine must fit into the legal definition and features of legal personhood to qualify as an inventor. In the UK's consultation on AI and IP in June 2022, the UK adopted a position that there will not be any need to make changes to the UK's patent law to recognise AI personhood, since there was no evidence demonstrating that the UK's patent system is inappropriate to protect inventions that were made by AI. The UK however recognised that a uniform change at the international level is more desirable to provide more certainty and clarity on the personality of an AI regarding inventorship.[181]

Another argument considered that different players within the AI innovation ecosystem may seek patent for resulting AI autonomous inventions where they contribute to the invention.[182] Consequently, companies or individuals that develop software to generate inventions should be entitled to the invention.[183] The third argument proposes that patent protection for AI inventions should be abolished. This argument was premised on the assumption that the patent system is ill-equipped to handle AI inventions. The justification for this proposal stems from the fact that since legislatively and judicially, AI is not qualified to own its invention and humans are arguably incapable of claiming inventorship or ownership over the autonomous invention. Consequently, the patent law is therefore unable to optimise AI innovation.[184]

Arguing against patenting AI autonomous invention, McLaughlin posited that if AI autonomous invention becomes patentable, it will enable the creation of private fortunes for the privileged few that can afford inventing technologies. According to him, this will result to exclusivity over public enjoyment and to avoid this situation, he argued that AI autonomous invention should remain unpatentable.[185]

From the judicial and the administrative positions regarding inventorship, a possible legal implication is the fact that patent eligible but unpatented AI inventions (because of lack of inventors) will automatically form part of the

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state of the art or prior arts. Consequently, over time, there is a risk that all or most future human and AI inventions could become obvious without anyone taking credit for the invention. A situation where neither the owner nor the AI machine can claim inventorship does not optimise the patent system which aims to incentivise technological innovations. Consequently, a human inventor that will bridge the gap between inventorship and ownership has become imperative.[186] To avoid AI inventions defaulting into prior arts, is it possible for the human collaborator(s) who programmed and/or own the computer to be regarded as the inventor? Where this is possible, a legal hurdle is whether the programmer and/or owner can be said to satisfy the requirements of actual deviser and the conception and reduction to practice.

1.8.1 | Towards an optimal patent mechanism: A case for AI stakeholders

The Australian full High Court in *Dr Thaler* (supra) identified certain proprietary interests in the R&D processes involving an AI machine. Some of them include the owner of the machine where the intelligence software runs, the developer of the AI software, the owner of the copyright in its source, and the person who designs and inputs the data that was used by the AI to develop the output.[187]

The stakeholders or the multiplayers in AI R&D processes have been identified earlier.[188] Remarkedly, it is identified that the roles of AI programmer, owner, the trainer and the operators stand out in the R&D processes. These players and the extent of their involvement raise the question of who can claim inventorship and ownership of AI autonomous inventions.[189] It is imperative to determine the degrees of human intervention that may take place throughout the inventive process,[190] that will necessitate granting inventorship to a stakeholder(s).

Conception is critical to inventorship. Unless a person contributes to the conception of the invention, he is not an inventor.[191] As required, conception is expected to be contemporaneous with the invention and it is a matter of proof.[192] The requirements of conception and actual deviser highlight the extent inventors are involved in R&D processes to qualify as either sole or joint inventor. Any of the highlighted AI stakeholders or players[193] that can demonstrate contributions to the conception of the invention, or the inventive process can claim inventorship.

AI machine engages in a self-learning especially where the AI is unsupervised, the data is unlabelled, or it is engaging in reinforcement,[194] to develop an invention. This can raise a significant concern that the creator and/or programmer and other relevant stakeholder of the machine may or may not have contributed to the autonomous invention. More so, where the inventive outcome was not ordinarily envisaged by any of the relevant parties. In this situation, the owner and/or the programmer, data suppliers and other key stakeholders may be unable to expressly satisfy the requirement of 'actual deviser[195] or conception'.[196]

The mental element threshold of inventorship can present a significant obstacle to the possibility that the inventor of the AI, owner, and/or programmer will be considered as possible inventor of an AI autonomous invention. As earlier identified in the preceding discussions, the consensus is that AI machines have not achieved full sophistication, autonomy, and human cognition to invent without human collaboration[197] and prompts. Pending when this is achieved (if at all), human involvement (no matter how small) could mean a joint action between the AI machine and the relevant collaborator. Despite this premise, there has been a contrary argument against stakeholder inventors. Clifford argued that some of the stakeholders like the user of a creative machine cannot obtain a patent because they did not conceive the invention.[198]

Arguably, there is a possibility that in the R&D process undertaken by an AI machine, the owner and/or programmer/user/trainer of the machine may provide supports or interventions that can significantly alter the process to generate a patent-eligible outcome even though the invention can be termed autonomous. This is easier where the process is supervised, and the data is labelled because the outcome is foreseeable.[199] When any of these happens, the natural person and the machine can be argued to have played joint roles in conceiving or devising the invention.[200] The unique barrier for the machine entity is that as nonhuman, it lacks the mental ability to

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conceive and does not qualify as an inventor. This leaves the human entity with the chance to demonstrate or proof contribution to conception.

Ravid et al captured the specific roles played by stakeholders in AI innovation. The software developer develops the software that runs the AI machine and undoubtedly owns the copyright to it. The programmer creates the AI software programme algorithm however, he/she does not target the final goal of the AI system. A data supplier exposes the AI system to the data it will exploit to 'learn' how to function and achieve its goals. AI trainers intervenes to check and correct the results of the AI system when necessary. On the other hand, the owners of the AI system clearly own the AI and the operators or users could be an entity that licensed the AI system from the owner or those working with the owner as service providers.[201] These stakeholders play varying roles within the AI ecosystem. Consequently, any of the stakeholders can claim inventorship provided the requirements are satisfied.

Assuming the AI owner/programmer or any the stakeholder seeks inventorship, the question is whether the programmer formed a 'definite and permanent idea of the complete and operative invention' to establish conception.[202] Where the outcome is foreseeable and expected, it is easier to prove or demonstrate conception to claim inventorship.[203] As conception is a mental act, it is measured by what was operating in the mind of the inventor.[204] Consequently, the onus rests on the natural person to prove his/her contribution and demonstrate that the invention was conceived in his mind not what he thought.[205] This is usually easier to prove where the computer was programmed to invent the resulting outcome.

It is required that a claim to inventorship should be corroborated with evidence of contemporaneous disclosure or reduction to practice that would enable a person skilled in the art to make the invention.[206] However, contemporaneity can still be achieved at the point when a patent application with sufficient disclosure has been filed or when the invention is carried out and is found to work for its intended purposes.[207] It follows that contemporaneity might not be a strict requirement of conception. Consequently, it is possible for the courts and national IPOs to rely on 'simultaneous conception and reduction to practice' to confer inventorship on any AI stakeholder(s) that can demonstrate some contributions after the reduction of the invention into practice. This approach has become necessary because it may not be possible for a stakeholder to achieve full conception before the AI inventive outcome arrives and subsequently determined to work.

1.8.2 | Potential reliance on simultaneous conception and reduction to practice

The doctrine of simultaneous conception and reduction to practice recognises that in some unpredictable innovation fields there can be no conception of an invention until the invention has been reduced to practice.[208] Where an inventor is unable to establish conception until he has reduced the invention to practice through a successful experiment, simultaneous conception and reduction to practice occur.[209] It is arguable that where an AI owner/programmer who programmed the AI machine to mimic human cognition is unable to demonstrate contemporaneity of conception and reduction to practice, he/she can argue 'simultaneous conception and reduction to practice'[210] to prove conception.

Over the years, some courts have recognised inventions that were unanticipated from what was originally expected from an R&D process. The inventions were not abandoned because they were accidental.[211] Courts have been willing to recognise unanticipated inventions by applying the doctrine of 'simultaneous conception and reduction to practice'[212] especially for unpredictable fields like chemicals and biotechnologies.[213,214]

Where an inventor cannot imagine the form of the invention in advance of actually having reduced the invention to practice, patent law has held that the invention is conceived when it is eventually recognised by the inventor.[215] It is also possible for a person to qualify as an inventor by being the first individual to recognise and appreciate an AI invention.[216] This implies that a person's understanding of the relevance of an invention qualifies the person as an inventor.[217]

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Applying this reasoning implies that it is possible that the AI programmer/owner or any other stakeholder may not anticipate the resulting patentable AI invention. Nonetheless, when the invention is reduced into practice and he/she understands the relevance of the inventive concept, he/she can be said to have demonstrated conception. The application of this doctrine was applied in *Amgen Inc, V Chugai Pharm Co. Ltd*,[218] where the court held that there was no conception of an isolated DNA encoding human erythropoietin until the DNA molecule itself had been isolated and thus actually reduced to practice.[219]

In justifying the doctrine of simultaneous conception and reduction to practice, the strict application of contemporaneous conception and reduction has been argued to impose upon an AI owner/programmer and other relevant stakeholders a labour or the sweat of the brow standard to obtaining a patent.[220] This argument is consistent with 35 USC 103 which provides that patentability shall not be negated by the way the invention was made. It is therefore of no consequence that the invention resulted from long toil and experimentation or from a flash of genius.[221]

The application of the sweat rule would mean that unexpected discoveries or inventions are exempted from patent protection because conception did not happen before reduction to practice. Dan Burke made an analogous comparison. He posited that going by the requirement of contemporaneous conception and reduction to practice, inventions that occur by accident that were unforeseen at the start of the innovation process would be unpatentable. To avoid such a scenario, Burke argued that even the inventors who expected a different outcome or no outcome at all should be entitled to the same rights as inventors who methodically planned and executed their research programme. Inventors who generated a novel, useful, and nonobvious device on their first try, with little or no hard work, should receive the same consideration as inventors who succeeded only after laborious efforts.[222] Provided there is evidence that the person claiming inventorship of an AI autonomous invention did in fact programme or contributed to the process and to the inventive concept, he/she may qualify to be named an inventor.

Where the issue of inventorship is resolved in favour of the AI owner/programmer or any other person that demonstrates conception, patent entitlement or ownership can be resolved easily in favour of the person. The requirements of s.13(2) of the UK Patent Act can easily be established. Remarkedly, the full Australian High court in Comptroller of Patent V Dr Thaler (supra) declined to decide on patent entitlement or ownership because there was no legally qualified inventor.[223]

The preceding analysis and argument that an AI machine stakeholder(s) can qualify as inventor suggests the need to ensure that most AI generated inventions do not automatically form part of prior art or state of the art. This line of argument incentivises AI machine owner/programmers towards the creation of AI machines. This paper will now proceed to consider the justifications for recognising a human inventor in AI innovation.

1.8.3 | Justifying inventorship on AI stakeholders

Some scholars have asked whether nonrecognition of AI machine as an inventor is optimal and wondered how the situation will affect patent's net social welfare.[224] In proposing the Coase economic theory, Schuster considered that a system that promotes efficient allocation of patent rights for inventions should be pursued. Schuster suggested that to maximise social welfare, patent rights should be allocated to AI users who utilise the software for invention because they hold and consider it of great value.[225]

Ideally, the Coase theorem requires that courts should award entitlement to an invention to the party that values it the most to maximise economic efficiency.[226] Schuster's standard of value is a person that has the highest probability of engaging in the commerce that is associated with the AI invention.[227] Schuster identified the following participants in the chain of AI inventions that might be considered for patent ownership. Researchers, programmers who design and write AI packages, and AI users who buy or license AI for use. He further considered other downstream parties that may encounter the AI-produced inventions. They include product engineers,

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technical experts, and so on.[228] Overall, he considers that AI users participate in the market in a relevant way, hence, it should be allocated the patent rights to maximise social welfare. It can be highlighted that this approach also presents a difficult situation of how to determine who values the invention in a way that will maximise economic efficiency. It is arguable that such value should stem from the contributions of the AI users to the invention that can satisfy the inventorship threshold.

Abbott ordinarily favours naming an AI machine an inventor.[229] However he posited an alternative argument. He suggested that where the AI machine cannot be an inventor, the AI machine owner should be considered the default assignee of the invention. This according to him would incentivise the owners towards continued innovation.[230] He also considers the AI developer (which is the person that programmed the AI software) or the user who gives the AI the tasks to perform (which can be the same person as the owner) as possible inventors. According to Abbott, ownership right to computational inventions should vest in the computer's owner because it would be most consistent with the way personal property should be held.[231] He premised his contention on the fact that the owner would provide a direct economic incentive for developers in the form of increased consumer demand and creative computers.[232] Abbott's argument no doubt draws from his understanding of the role Dr Thaler played in designing DABUS machine and the DABUS's autonomous invention. It seems optimal to confer inventorship on stakeholder that understands both the machine and the new autonomous invention.

On the other hand, McLaughlin argued that awarding inventorship to any of the stakeholder would depend on whether there is sufficient nexus to human inventorship that is deserving of societal award. Arguing from the point of view of the Lockean patent theory, he posited that rewarding the labour of an inventor depends on whether the labour is derived from the inventor's actual handiwork.[233] McLaughlin's argument is consistent with the view that the closest person to be assigned inventorship is the person that demonstrates closer proprietary interest. As earlier highlighted, this person is arguably the stakeholder that can proof contemporaneous or simultaneous conception and reduction to practice.

2 | CONCLUSIONS

Overall, the current legislative framework and the judicial interpretations of inventorship may not adequately serve the proinnovation stance that have been taken by many countries to lead in AI innovation. Adopting a separate personhood for AI machine as suggested by the EU parliament could provide a temporary solution. However, it fails to address the unresolved inventorship tussle. The suggested strategic approaches to maximise patent mechanism imposes obligations on IPOs, the courts, and the policy makers to ensure that the patent legal framework is exploited flexibly to balance patent incentives towards ensuring continued R&D in AI innovation.

DATA AVAILABILITY STATEMENT

Data sharing is not applicable to this article as no new data were created or analyzed in this study.

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