Patentability of AI-Generated Inventions: A Comparative Analysis of Global Patent Law Frameworks and their Adaptation to Artificial Intelligence Innovation

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Abstract

The rapid advancement of artificial intelligence systems capable of autonomous invention has exposed fundamental inadequacies in existing patent law frameworks, which were conceived under the presumption of human inventorship. Current patent regimes across major jurisdictions struggle to address critical questions regarding inventorship attribution, disclosure requirements, and patentability criteria when inventions emerge from AI systems with minimal human intervention. The legal uncertainty surrounding AI-generated inventions threatens to undermine both innovation incentives and the foundational principles of patent law, creating a regulatory gap that demands urgent attention.

This study employs a comparative legal analysis methodology, examining patent law frameworks and judicial decisions across major jurisdictions: the United States, European Union, United Kingdom, Japan, India and Australia. The research synthesizes statutory provisions, patent office guidelines, court decisions, and administrative rulings to identify emerging patterns and divergent approaches. The analysis is supplemented by an examination of significant case studies, particularly the DABUS patent applications, and review of industry practices in AI-driven innovation sectors.

The research reveals a fundamental schism in global patent systems' treatment of AI-generated inventions. While some jurisdictions maintain strict human inventorship requirements, others are exploring adaptive frameworks that could accommodate non-human invention processes. The study identifies three primary approaches: restrictive human-centric models, flexible attribution systems, and emerging hybrid frameworks. Critical patentability challenges include the inadequacy of traditional disclosure requirements for AI-generated inventions, difficulties in applying obviousness standards to machine learning outputs, and the philosophical tension between rewarding human creativity and incentivizing AI development.

The fragmented global response to AI inventorship threatens to create significant disparities in innovation protection and commercialization strategies across borders. The findings suggest that current legal uncertainty may be deterring investment in AI research and development while simultaneously creating opportunities for forum shopping and strategic patent filing behaviors. The study concludes that

coordinated international reform is essential to maintain the patent system's role in promoting innovation while adapting to the realities of AI-driven technological advancement.

Keywords: artificial intelligence, patent law, inventorship, intellectual property, innovation policy, DABUS, comparative legal analysis

1. INTRODUCTION

The intersection of artificial intelligence and intellectual property law has reached a critical juncture that demands immediate scholarly and practical attention. In 2019, an AI system named DABUS (Device for the Autonomous Boot-strapping of Unified Sentience) autonomously conceived two inventions: a fractal food container designed to improve heat transfer and grip, and a flashing light system for emergency vehicles that mimics neural activity patterns. These inventions, created without human intervention beyond the initial programming of the AI system, were subsequently the subject of patent applications filed across multiple jurisdictions worldwide. The resulting legal battles have illuminated profound gaps in patent law's capacity to address the emergence of non-human inventors, fundamentally challenging centuries-old assumptions about the nature of invention and creativity.

The DABUS cases represent merely the tip of an intellectual property iceberg that grows larger with each advancement in machine learning, neural networks, and autonomous systems. In pharmaceutical research, AI systems like DeepMind's AlphaFold have revolutionized protein structure prediction, potentially leading to breakthrough drug discoveries. IBM's Watson has contributed to cancer treatment innovations, while AI systems in materials science have identified novel compounds and manufacturing processes. Google's AutoML has created machine learning models that surpass human-designed architectures, and AI-driven engineering systems routinely generate optimized designs for everything from aircraft components to semiconductor layouts. These developments raise fundamental questions: If an AI system independently develops a patentable invention, who should be considered the inventor? How should patent law adapt to accommodate inventions that emerge from algorithmic processes rather than human insight?
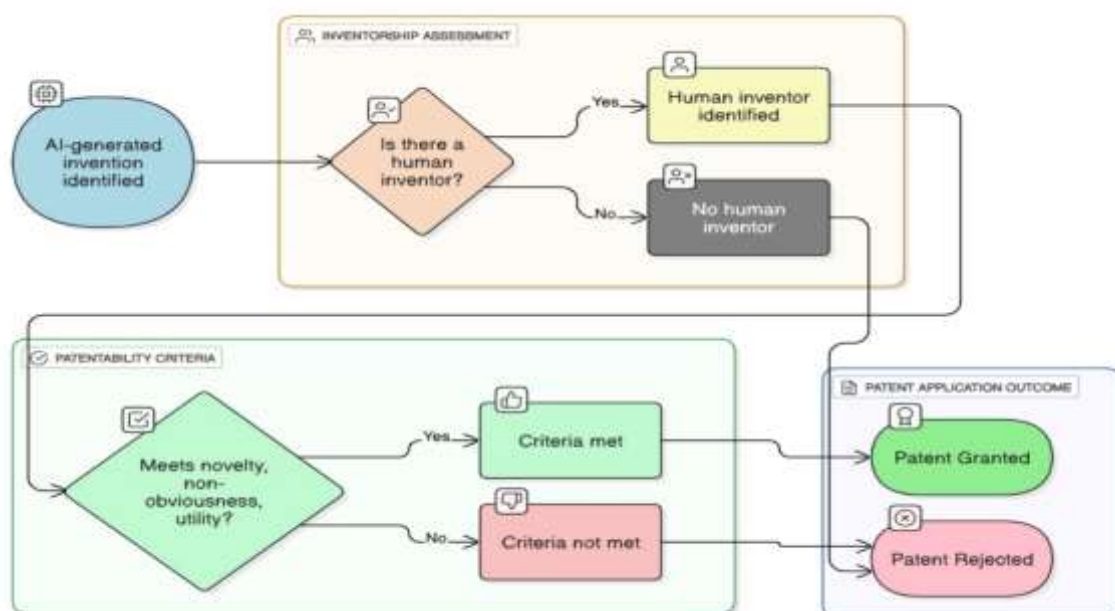
Figure 1: Eligibility Process For AI Generated Inventions

A. Problem Statement

The current patent law framework operates on foundational assumptions that are increasingly incompatible with technological reality. Patent systems worldwide were constructed around the concept of human inventors, requiring that applications identify natural persons as inventors and that these individuals understand and can describe their inventions. This human-centric model faces unprecedented challenges when confronted with AI systems capable of autonomous invention. The gap between current patent law and AI capabilities manifests in several critical areas: inventorship attribution becomes problematic when AI systems generate inventions independently; traditional disclosure requirements may be inadequate for explaining AI-generated inventions whose creation processes involve complex algorithmic operations; and established patentability criteria such as non-obviousness become difficult to assess when applied to machine learning outputs that may appear obvious to AI systems but revolutionary to human experts.

Furthermore, the temporal aspects of patent law conflict with AI invention timelines. While human invention typically involves identifiable moments of conception and reduction to practice, AI-generated inventions may emerge from continuous learning processes without clear temporal boundaries. The collaborative nature of AI development, involving multiple programmers, data scientists, and system operators, complicates traditional notions of inventorship, which assume clear attribution to specific individuals. These challenges are compounded by the global nature of AI development and deployment, which requires harmonized international approaches to maintain coherent patent protection strategies.

B. Research Objectives

This comprehensive study aims to address the critical knowledge gap in understanding how patent law should evolve to accommodate AI-generated inventions while preserving the fundamental incentive structures that drive innovation. The research seeks to achieve several interconnected objectives. First, it provides a systematic comparative analysis of how major patent jurisdictions currently address AI inventorship, identifying patterns, divergences, and emerging trends in legal approaches. Second, it examines the practical implications of different legal frameworks for innovation ecosystems, including their effects on research and development investments, competitive dynamics, and international technology transfer. Third, it evaluates the adequacy of existing patent law doctrines—including inventorship, disclosure, utility, novelty, and non-obviousness—when applied to AI-generated inventions.

The study also aims to identify the most promising legal and policy approaches for addressing AI inventorship challenges while maintaining patent law's essential functions of promoting innovation disclosure and providing temporary exclusivity rights. Additionally, it seeks to provide practical guidance for patent practitioners, technology companies, and policymakers navigating the current landscape of legal uncertainty surrounding AI-generated inventions.

C. Significance

The resolution of AI inventorship questions carries profound implications for multiple stakeholders and the broader innovation ecosystem. For the legal profession, these issues represent one of the most significant challenges to traditional intellectual property doctrine since the emergence of biotechnology patents. The outcomes of current legal debates will establish precedents that shape patent law for decades, potentially affecting billions of dollars in research and development investments across industries from pharmaceuticals to autonomous vehicles.

From a business perspective, legal uncertainty surrounding AI-generated inventions creates strategic

challenges for technology companies investing heavily in AI research. Companies must navigate conflicting jurisdictional approaches while making critical decisions about patent filing strategies, research collaboration structures, and intellectual property portfolios. The stakes are particularly high in sectors where AI-driven innovation is becoming dominant, including drug discovery, materials science, and autonomous systems development.

The innovation ecosystem implications extend beyond im- mediate commercial interests. Patent law serves the crucial function of encouraging disclosure of inventions in exchange for temporary exclusivity rights, thereby advancing the state of technological knowledge for society's benefit. If AI-generated inventions cannot be adequately protected or disclosed through existing patent mechanisms, this fundamental bargain may be disrupted, potentially reducing incentives for AI research and limiting public access to technological advances.

Moreover, the international dimension of AI development means that fragmented patent approaches could lead to regulatory arbitrage, where companies relocate research activities to jurisdictions with more favourable AI patent policies. Such dynamics could influence global patterns of innovation investment and technological leadership, with significant economic and strategic implications for nations and regions.

2. Literature Review

A. Traditional Patent Theory

Inventorship Requirements and Human Inventor Presumption

The traditional patent system assumes human inventorship, requiring that a named inventor be a natural person. This is grounded in historical patent doctrines, where creativity, intention, and contribution are key elements—attributes associated with humans. AI-generated inventions challenge this presumption, raising questions on whether AI systems can truly be inventors under existing frameworks [1], [3].

Utility, Novelty, and Non-Obviousness Criteria

Traditional patentability hinges on three criteria: utility, novelty, and non-obviousness. While AI-generated inventions may satisfy these on technical grounds, challenges arise in demonstrating the inventive step, especially when AI outputs are perceived as routine or algorithmic. Odeh [3] and Bhardwaj [4] discuss these issues, emphasizing the interpretive burden on patent offices.

B. AI and Patent Law Intersection

Early Scholarship on Computer-Generated Inventions

Initial discourse centered around whether outputs by non-human agents could qualify for IP protection. Early papers like Odeh's [3] raised foundational questions about the compatibility of non-human inventors with the human-centric IP regimes.

Recent Debates on AI Inventorship

Recent works focus on real-world legal conflicts such as Dr. Stephen Thaler's DABUS case, where patent applications listing AI as the inventor were rejected in multiple jurisdictions [2], [4]. Nguyen and Quan [2] and Bhardwaj [4] highlight how jurisdictions vary in interpreting the need for a natural person as an inventor.

Philosophical Questions about Creativity and Invention

The concept of "creativity" is inherently philosophical and normative. De Rassenfosse et al. [1] and Silva et al. [5] explore whether machine outputs can be considered truly creative and whether traditional legal definitions need adaptation to accommodate AI as a co-inventor or tool.

C. Comparative Legal Approaches

Different Jurisdictions' Responses

Nguyen and Quan [2], Bhardwaj [4], and Silva et al. [5] offer comparative analyses of AI-inventorship responses across jurisdictions. For instance:

- USA & UK: Require a natural person as inventor.
- India: Lacks a clear AI-specific policy but follows a conservative approach.
- Lithuania and EU: Tentative to adapt, citing ambiguity in law [5].

Emerging Trends and Divergences in Patentability of AI-Generated Inventions

The need for reforms is consistently echoed across papers. De Rassenfosse et al. [1] argue for a differentiated patent system, while Tombekai [6] reviews international frameworks like the TRIPS Agreement and calls for unified policy direction. The divergence in national approaches suggests the emergence of fragmented norms, potentially affecting global innovation policy.

3. Case Studies

A. The DABUS Case

The DABUS case marks a major turning point in the debate over whether AI can be recognized as an inventor under patent law. DABUS, developed by Dr. Stephen Thaler, is an AI system that autonomously created two inventions: a food container suited for robotic use and a light-emitting device for emergencies. Dr. Thaler filed patent applications in multiple jurisdictions, including the US, UK, EU, Australia, South Africa, and India, naming DABUS as the sole inventor. While South Africa granted the patent due to its lenient depository system, most other jurisdictions—including the US, UK, and EU—rejected the application on the grounds that inventorship requires a natural person.

In India, the Patents Act, 1970, mandates that only a "person" can apply for a patent, which, under Indian law, excludes AI systems. Inventions must also involve human ingenuity, as implied by Section 2(1)(j) of the Act. Since AI cannot hold property or be legally accountable, it cannot currently be named as an inventor or patent holder under Indian law. This creates challenges around ownership, accountability, and attribution when an AI independently generates a patentable idea.

The DABUS case has revealed significant legal and ethical gaps in current patent systems, particularly around who should be credited for AI-generated inventions—the developer, the user, or no one. It also raises concerns about how AI-driven inventions might affect the value of human creativity in the patent system. For India, the case underscores the need to reassess its intellectual property laws. While full legal recognition of AI as an inventor may not be immediately feasible, a balanced approach—such as acknowledging AI-assisted inventions while retaining human inventorship—could foster innovation without undermining the legal structure.

B. Industry Examples

The use of artificial intelligence in drug discovery is revolutionizing the pharmaceutical industry by accelerating research timelines and optimizing processes. AI systems like DeepMind's AlphaFold2 have demonstrated the ability to predict protein structures with unprecedented accuracy, enabling the rapid identification of drug candidates. However, this innovation also introduces legal complexity around inventorship and patentability. The U.S. Patent and Trademark Office (USPTO), for instance, requires a human to make a "significant contribution" to the invention. While using AI tools does not disqualify a patent, the human role must go beyond passive use, such as designing experiments or training models. Additionally, the "black box" nature of some AI models raises challenges in meeting disclosure

requirements, which are crucial in patent applications. These ambiguities demand more refined legal standards to govern AI-assisted drug invention.

Similarly, in industrial design, AI is challenging traditional notions of creativity and authorship. Generative design software can autonomously produce visually unique and market-ready products, from consumer electronics to furniture. However, patent laws remain ill-equipped to deal with non-human creators. Design patents require human inventors, which excludes AI-generated outputs under current frameworks. The well-known DABUS case highlighted this issue, where an AI-generated product design was denied patent protection due to the absence of a human inventor. This raises important questions about ownership and credit: should the user, developer, or owner of the AI be recognised, or should new legal categories be created? Suggestions like collaborative inventorship or legal recognition of AI-assisted works point to a growing need for reform, particularly as AI becomes more autonomous in design creation.

Both examples underscore a common challenge: existing intellectual property laws are struggling to keep pace with AI's expanding creative and analytical capabilities. While AI can significantly accelerate innovation and reduce costs, the absence of clear legal recognition for AI-generated outputs creates uncertainty for inventors, businesses, and investors. Moving forward, regulatory frameworks must evolve to acknowledge AI's role—whether through legislative amendments, interpretative guidance, or the creation of new rights structures. Without this evolution, we risk stifling progress in industries that stand to benefit most from the integration of AI technologies.

C. Emerging Patterns

Emerging trends in AI-related patent applications reveal a growing focus on generative AI and specialization within subfields. Countries like China are leading in filings related to generative modeling, while regions such as the U.S. and EU are shifting toward securing high-quality, technically significant patents rather than prioritizing volume. Additionally, patent examiners are increasingly requiring claims to demonstrate practical technical improvements, moving away from abstract ideas, especially in line with updated guidance under the USPTO's Alice/Mayo framework.

Another notable pattern is AI's evolving influence on standards of obviousness and enablement. Courts are beginning to treat routine AI usage as part of the baseline knowledge of a skilled person, which could render AI-assisted inventions unpatentable if they lack clear innovation. The rise of AI-generated prior art further complicates novelty and non-obviousness assessments, as these references may be widespread yet lack traditional concepts of authorship or public accessibility, thereby challenging the validity of existing patents.

Finally, AI is becoming not only a subject of patent protection but also a powerful tool within the patent process itself. AI-driven systems for prior art searches, patent drafting, and predictive analytics are now being integrated into examination workflows, improving efficiency and enhancing patent quality. Altogether, these shifts reflect a patent landscape that is increasingly rigorous, strategically refined, and shaped by data-driven decision-making—demanding that innovators adapt both legally and technically.

4. Analysis and Discussion

This section delves into the core legal, policy, and practical challenges surrounding the patentability of AI-generated inventions. As artificial intelligence systems increasingly contribute to technological innovation, they also expose significant gaps and ambiguities in the current intellectual property (IP) framework. The discussion begins by identifying limitations in the existing legal structures, especially in

how they handle inventorship, disclosure, and novelty assessment in the context of AI. It then moves on to evaluate the broader policy implications of granting patents for AI-generated outputs—highlighting tensions between innovation incentives, market fairness, and ethical considerations. Finally, the section proposes potential reforms and adaptive strategies to ensure the patent system remains relevant and equitable in an AI-driven future.

A. Current System Limitations

The existing patent framework, developed for human inventors, faces significant challenges when applied to AI-generated inventions. One of the foremost issues is inventorship attribution. Patent law traditionally requires naming a natural person as the inventor. However, AI systems like generative models and autonomous design tools are increasingly responsible for creating novel solutions without direct human intervention. Courts and patent offices, such as the USPTO and EPO, have consistently rejected applications that list an AI as an inventor, citing legal definitions rooted in human agency. This creates uncertainty for innovators using AI extensively, as excluding AI contributions could lead to disputes over rightful inventorship and ownership.

Disclosure requirements also pose a hurdle. Patent law mandates a sufficient and enabling disclosure to allow a person skilled in the art to reproduce the invention. When the inventive step involves opaque AI processes—such as neural network weights or training data not easily explainable—the adequacy of disclosure becomes questionable. This challenges the foundational principles of transparency and reproducibility in patent law, especially with complex deep learning systems whose internal workings are often not fully understood even by their creators.

Additionally, prior art and obviousness assessments are complicated by AI's ability to generate outputs that may be novel but derived from large volumes of existing data. AI systems can uncover non-obvious combinations that a human might not consider, yet they may still rely on pre-existing patterns, raising ambiguity about whether such inventions are truly inventive or merely computationally synthesised from prior art. Patent examiners are ill-equipped to evaluate the originality of AI-generated outcomes, as the lines between human creativity and algorithmic processing blur.

B. Policy Considerations

From a policy standpoint, one of the central concerns is innovation incentives. Patents are meant to reward human ingenuity and stimulate technological advancement. Allowing AI-generated inventions to be patented, especially without clear inventorship, raises questions about who receives the incentive and how this might affect human participation in R\&D. Striking a balance between encouraging AI development and ensuring that patents do not become monopolized by entities automating the inventive process is critical.

The economic impact of AI-generated patents must also be considered. If large corporations with access to advanced AI systems begin dominating patent filings, smaller players and startups could be marginalized, reducing competition and stifling market dynamics. There is a risk of patent thickets where overlapping claims create legal uncertainty and hamper follow-on innovation.

Ethical dimensions further complicate the landscape. Granting patents for AI-generated inventions could exacerbate inequalities in access to innovation. Questions arise about fairness: should entities be allowed exclusive rights over outputs of systems trained on publicly available data? Moreover, access to essential technologies—especially in healthcare and climate solutions—may be restricted if AI-generated patents are aggressively enforced.

C. Proposed Solutions

To address these limitations, several legislative reform options have been proposed. One approach is to explicitly amend patent laws to recognize non-human inventors or at least allow AI-assisted invention with revised criteria for inventorship. This could involve defining inventors as individuals who configure or supervise AI systems rather than those who directly conceive of an invention.

Administrative adaptations may involve updating patent examination protocols. Patent offices could develop AI-specific examination guidelines, including methods for assessing the transparency and reproducibility of AI-generated outputs, and perhaps even using AI tools to detect prior art in high-dimensional data.

Hybrid approaches suggest creating a new category of intellectual property tailored to AI-generated inventions. This could operate alongside the patent system, providing protection without requiring strict adherence to traditional inventorship and disclosure norms. Such a framework could preserve innovation incentives while acknowledging the unique characteristics of AI-based creativity.

5. Research gaps and Future Directions

The current state of research reveals several significant gaps that require further investigation:

A. Divergent Examination Practices

Lack of harmonised criteria for assessing the inventive step/non-obviousness of AI-generated inventions across the US, EU, and Japan. While legal frameworks are superficially similar, differences in guidelines create jurisdictional inconsistencies. For example, Japan and the US assume a "skilled person" with ordinary creativity, while the EPO restricts prior art evaluation to fields where AI is already widely used.

B. Subjective Inventive Step Evaluation

No clear methodology to determine whether an AI- AI-generated solution is "non-obvious" to: a human skilled in the art without AI tools, or a human using comparable AI systems. This creates risk of inconsistent outcomes due to examiner subjectivity.

C. Threshold for Human Contribution

Insufficient guidance on quantifying human input in AI- AI-assisted inventions to satisfy inventorship requirements (e.g., problem formulation vs. iterative refinement).

D. Policy Incentives

Unaddressed tension between maintaining patent quality (preventing AI-driven "patent flooding") and encouraging commercialization of AI innovations.

E. Technical Disclosure Standards

Ambiguity in documenting AI-specific elements like training datasets, model architectures, and decision-making processes to satisfy enablement requirements.

6. Implications and Recommendations

Building on the preceding analysis, this section outlines practical implications and strategic guidance for key stakeholders—legal practitioners, policymakers, and business leaders. As AI technologies increasingly intersect with the patent system, stakeholders must adapt to evolving risks, regulatory uncertainties, and competitive dynamics. Each sub-section presents tailored recommendations: legal professionals must reassess how they approach patent applications involving AI; policymakers must consider targeted reforms to modernize existing laws; and businesses must strategically manage their

intellectual property and innovation strategies. Together, these recommendations aim to promote a balanced and forward-looking approach to patenting in the age of artificial intelligence.

A. For Legal Practice

Legal practitioners must adapt their patent prosecution strategies to address AI's role in invention. This includes carefully documenting human contributions during the development process, even if AI performs the inventive act, to satisfy current inventorship requirements. Drafting claims that emphasise human oversight or guidance may increase patentability odds.

Client counselling considerations should involve educating clients on the risks and limitations of current patent law concerning AI. Lawyers must advise clients on best practices for record-keeping, disclosure documentation, and strategies for navigating potential inventorship challenges.

A robust risk assessment framework is needed to evaluate the vulnerability of AI-assisted inventions to legal challenges. This includes assessing prior art risks, inventorship disputes, and the possibility of non-enablement rejections due to insufficient AI-related disclosures.

B. For Policymakers

Policymakers should prioritize regulatory reform recommendations to modernize patent law for the AI age. This may include establishing a legal fiction of "AI-as-inventor" with rights vested in a human or corporate entity, or creating AI-specific protection regimes.

International coordination is essential. Disparate national approaches to AI inventorship create fragmentation and legal uncertainty in global IP protection. Harmonizing definitions and standards across jurisdictions can ensure a more stable and predictable innovation ecosystem.

Ultimately, policymakers must balance competing interests—rewarding innovation, ensuring fair competition, promoting public access, and preventing abuse of the patent system by monopolistic AI deployments. This demands input from technologists, ethicists, and economic experts in shaping a responsive IP framework.

C. For Business Strategy

Businesses leveraging AI in R&D must rethink their IP portfolio management. Companies should maintain comprehensive documentation of the development pipeline to establish clear inventorship and ownership claims, especially where human-AI collaboration is involved.

R&D investment decisions may shift as the boundaries of patent eligibility evolve. Firms might prioritize technologies where AI augments human inventors rather than fully autonomous invention, until the legal environment stabilizes.

Lastly, competitive positioning will depend on how effectively firms can navigate the AI-patent landscape. Early adoption of hybrid IP protection strategies, alignment with policy trends, and proactive legal foresight can create strategic advantages in a rapidly changing technological and regulatory domain.

7. Conclusion

The rise of artificial intelligence as a driver of innovation has exposed critical tensions within the traditional patent system—tensions rooted in human-centric concepts of inventorship, disclosure, and inventive step. While AI-generated inventions promise to accelerate technological progress, their integration into the intellectual property framework remains legally and ethically complex. This paper has analyzed the systemic limitations of current patent laws, evaluated policy and economic considerations, and proposed legislative and administrative reforms to address these challenges.

A key insight is that the existing legal infrastructure is ill-equipped to handle inventions created autonomously or semi-autonomously by AI. Without targeted reforms, there is a risk of stifling innovation, fostering legal uncertainty, and creating imbalances in competitive advantage. Policymakers, legal practitioners, and businesses all have a role to play in shaping a more inclusive and adaptive patent regime—one that both protects intellectual property and fosters equitable access to AI-driven advancements.

Ultimately, the patent system must evolve to reflect the realities of 21st-century innovation. Whether through legislative amendments, hybrid IP models, or international cooperation, proactive efforts are needed to ensure that AI-generated inventions are governed by a legal framework that is both forward-looking and fair. Only then can the full potential of AI in innovation be responsibly realized.

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