

## Legal Challenges of Generative Artificial Intelligence in Intellectual Property Protection

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**Abstract:** *The rapid diffusion of generative artificial intelligence (AI) systems capable of producing text, images, music, source code, and other expressive or functional outputs has exposed deep structural tensions within contemporary intellectual property (IP) law. Doctrines built around human authorship, inventive step, and identifiable infringing acts strain when confronted with machine-generated works, opaque training processes, and diffuse chains of causation between input data and output content. This article examines the legal challenges generative AI poses to copyright, patent, and related IP regimes, focusing on three interlocking problems: the (non-)recognition of AI systems and AI-assisted human creators as authors or inventors; the legality of using copyrighted works as training data without authorization or remuneration; and the adequacy of existing liability and governance frameworks to address infringement risks generated by foundation models. Using a normative juridical method combined with comparative and conceptual approaches, this article analyzes statutory provisions, judicial decisions such as, and recent international scholarship to map divergent regulatory responses across the United States, the European Union, China, India, and Indonesia. The findings indicate that no jurisdiction has yet produced a fully coherent doctrinal settlement; instead, a patchwork of judicial improvisation, administrative guidance, and emerging legislation such as the has developed. The article concludes that IP law requires targeted reform rather than wholesale replacement, including clarified human-authorship thresholds, statutory text-and-data-mining exceptions coupled with opt-out and transparency mechanisms, and graduated liability rules that distinguish developers, deployers, and end users of generative AI systems.*

**Keywords:** *Generative Artificial Intelligence; Intellectual Property; Copyright Authorship; Patent Inventorship; AI Governance.*

### INTRODUCTION

Generative artificial intelligence refers to a class of machine learning systems, typically built on large-scale neural network architectures, that are trained on vast corpora of text, images, audio, and code in order to generate novel outputs that resemble the statistical patterns of their training data.<sup>1</sup> Unlike earlier "discriminative" AI systems

designed primarily to classify or predict, generative systems such as large language models and diffusion-based image generators actively produce new expressive content: essays, poetry, source code, illustrations, music, and synthetic voices that are often indistinguishable, on their face, from human-made works. The speed and scale of this diffusion is unprecedented; within a few years

<sup>1</sup>Pamela Samuelson, "Generative AI Meets Copyright," *Science* 381, no. 6654 (2023): 158–161, <https://doi.org/10.1126/science.adi0656>.

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of the public release of transformer-based chatbots and text-to-image systems, hundreds of millions of users worldwide were routinely producing AI-assisted content for commercial, academic, journalistic, and creative purposes.

This technological shift has produced a genuine crisis of fit within intellectual property law. Copyright, patent, trademark, and trade secret doctrines were each developed around assumptions that no longer hold cleanly in the generative AI context: that a work has an identifiable human author whose personality and judgment are reflected in the final expression; that an invention proceeds from a natural person's conception of a solution to a technical problem; that the boundary between lawful inspiration and unlawful copying can be drawn by comparing two discrete, humanly authored works; and that liability for infringement can be traced to a specific act of reproduction, distribution, or communication to the public by an identifiable actor.<sup>2</sup> Generative AI destabilizes each of these assumptions simultaneously, because the "creative" process is mediated by a statistical model trained on millions of prior works, the model's internal operation is largely opaque even to its own developers, and outputs are produced at a volume and velocity that make case-by-case adjudication of originality and infringement practically unmanageable.

Three overlapping legal problems dominate the current discourse and structure the analysis in this article. The first is the

authorship and ownership problem: can a work generated wholly or substantially by an AI system qualify for copyright protection, and if so, who should be recognized as the author or owner — the AI developer, the deploying platform, the end user who supplied the prompt, or no one at all because the work falls into the public domain?<sup>3</sup> Courts and copyright offices in leading jurisdictions have so far converged on a human-authorship requirement, most visibly in the U.S. litigation<sup>4</sup>, yet the precise threshold of human creative contribution needed to sustain a valid copyright claim over an AI-assisted work remains contested and inconsistently applied.<sup>5</sup>

The second problem concerns the lawfulness of the training process itself. Generative models are typically trained by ingesting enormous datasets scraped from the internet, which routinely include copyrighted books, news articles, photographs, and source code, without individualized licenses or, in many cases, without the knowledge of the rightsholders.<sup>6</sup> Whether such large-scale reproduction for training purposes constitutes copyright infringement, or instead falls within exceptions such as the United States' fair use doctrine or the European Union's text-and-data-mining exceptions, is one of the most consequential unresolved questions in contemporary IP law, with billions of dollars and the business models of an entire industry riding on the outcome.<sup>7</sup>

<sup>2</sup>A. Asghar, "Artificial Intelligence and Intellectual Property Law: Authorship, Ownership, and Liability in the Age of Generative AI," SSRN Electronic Journal (2026), <https://doi.org/10.2139/ssrn.6510059>.

<sup>3</sup>A. Fontana, "Intellectual Property Protection in the Era of Artificial Intelligence and the Problem of Generative Platforms," *The Journal of World Intellectual Property* (2025), <https://doi.org/10.1111/jwip.12355>.

<sup>4</sup>Thaler v. Perlmutter, op. cit.

<sup>5</sup>P. Pakshin, "Criteria for the Legal Protection of Artificial Intelligence-Generated Intellectual Property," *Legal Issues in the Digital Age* (2025), <https://doi.org/10.17323/2713-2749.2025.3.52.76>.

<sup>6</sup>Nicola Lucchi, "ChatGPT: A Case Study on Copyright Challenges for Generative Artificial Intelligence Systems," *European Journal of Risk Regulation* 15 (2023): 602–624, <https://doi.org/10.1017/err.2023.59>.

<sup>7</sup>Simon Chesterman, "Good Models Borrow, Great Models Steal: Intellectual Property Rights and

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The third problem is one of liability and governance: when a generative AI system produces an output that infringes a third party's copyright, trademark, or patent rights — for instance by reproducing a licensed character, mimicking a distinctive artistic style, or regurgitating a substantial verbatim excerpt of a training document — who bears legal responsibility, and through what regulatory architecture should such risks be managed prospectively rather than merely litigated after the fact? <sup>8</sup> Regulators in China, the European Union, and elsewhere have begun to answer this question through administrative measures, algorithm registration regimes, and comprehensive AI statutes, while others, including the United States, have so far relied primarily on existing IP statutes supplemented by case-by-case judicial interpretation. <sup>9</sup>

These three problems are not merely theoretical. They have generated a wave of high-profile litigation against major AI developers by authors, visual artists, news publishers, and stock-image libraries in the United States and elsewhere, alongside parallel regulatory interventions such as the <sup>10</sup>, China's administrative measures for generative AI services, and ongoing policy debates in India, Indonesia, and other developing economies regarding how to balance innovation incentives against the protection of creative and inventive labor. <sup>11</sup> Indonesian scholarship has likewise

begun to engage directly with these questions, recognizing both the urgency of adapting the national copyright framework under <sup>12</sup> to generative technologies and the practical challenges of enforcement in a rapidly digitalizing creative economy. <sup>13</sup>

Against this backdrop, this article addresses two central research questions. First, how do the doctrinal categories of authorship, originality, and inventorship in copyright and patent law apply — or fail to apply — to works and inventions produced with substantial involvement of generative AI systems? Second, how should legal liability for IP infringement arising from the training and deployment of generative AI be allocated among developers, deployers, and users, and what regulatory instruments are best suited to manage these risks going forward? The article argues that existing IP doctrine, though strained, retains sufficient conceptual resources to accommodate generative AI provided it is supplemented by targeted statutory reform: a clarified and internationally harmonized human-authorship threshold, a carefully calibrated text-and-data-mining exception balanced by opt-out and transparency obligations, and a graduated liability framework that reflects the differentiated roles of model developers, platform deployers, and prompting users. <sup>14</sup>

Generative AI," SSRN Electronic Journal (2024), <https://doi.org/10.2139/ssrn.4590006>.

<sup>8</sup>Qiufang Zhang and Ning Huang, "Legal Risks and Governance Approaches of Generative Artificial Intelligence," *Journal of AI Ethics and Legal* (2025), <https://doi.org/10.37420/j.aiel.002>.

<sup>9</sup>Araz Taeihagh, "Governance of Generative AI," *Policy and Society* (2025), <https://doi.org/10.1093/polsoc/puaf001>.

<sup>10</sup>EU AI Act (Regulation (EU) 2024/1689), op. cit.

<sup>11</sup>Shinu Vig, "Intersection of Generative Artificial Intelligence and Copyright: An Indian Perspective," *Journal of Science and Technology*

*Policy Management* (2024), <https://doi.org/10.1108/jstpm-08-2023-0145>.

<sup>12</sup>Undang-Undang Nomor 28 Tahun 2014 tentang Hak Cipta, Lembaran Negara Republik Indonesia Tahun 2014 Nomor 266.

<sup>13</sup>Yuka Latieful Mantiqa, Mulida Hayati, and Satriya Nugraha, "Generative AI in the Context of Intellectual Property Law: Urgency, Challenges, and Legal Protection," *Journal of Law, Politic and Humanities* 5, no. 6 (2025), <https://doi.org/10.38035/jlph.v5i6.2160>.

<sup>14</sup>Arjit Kandalai, "Algorithmic Ownership in the Age of Generative Artificial Intelligence: Reconciling Intellectual Property Regimes with Sociotechnical Imperatives," *International Journal*

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The urgency of these questions is compounded by the sheer commercial scale now attached to generative AI. Major technology companies have invested tens of billions of dollars in foundation-model development, and derivative markets for AI-assisted content — from marketing copy to concept art to software scaffolding — now touch nearly every sector of the creative and knowledge economy.<sup>15</sup> This commercial scale changes the stakes of doctrinal uncertainty: where earlier generations of copyright disputes typically concerned discrete works and identifiable defendants, generative AI litigation implicates training corpora comprising billions of individual copyrighted items and output volumes that make traditional, work-by-work adjudication of infringement claims increasingly impractical without new procedural and evidentiary tools.<sup>16</sup> The resulting uncertainty is costly not only to rightsholders seeking redress but also to AI developers and downstream businesses seeking to build durable products atop a still-unsettled legal foundation, and to the broader public interest in a predictable innovation environment.<sup>17</sup>

It is also important to situate the present inquiry within the longer history of IP law's repeated encounters with disruptive reproduction and creation technologies, from the printing press and photography to photocopying, sound recording, and digital file-

sharing.<sup>18</sup> Each of these earlier technologies provoked comparable anxieties about the erosion of authorial control and the viability of existing incentive structures, and each was eventually accommodated through some combination of new statutory categories, judicially developed doctrines such as fair use and fair dealing, and administrative licensing schemes. Generative AI differs from these precedents in degree rather than necessarily in kind — the volume, speed, and apparent autonomy of machine-generated output are without close historical analogue — but the pattern of legal adaptation observed in earlier technological disruptions offers at least a partial template, and a measure of reassurance, for the reform process this article ultimately recommends.<sup>19</sup>

The remainder of this article proceeds as follows. Section 2 outlines the normative juridical research method employed, including the statutory, conceptual, and comparative approaches used to analyze primary and secondary legal materials. Section 3 presents the results and discussion in two subchapters: the first examines authorship, originality, and ownership disputes over AI-generated and AI-assisted works, including a review of the<sup>20</sup> litigation and comparable disputes over patent inventorship; the second examines infringement liability arising from training data practices and surveys emerging regulatory and governance responses across multiple

for Multidisciplinary Research (2026), <https://doi.org/10.36948/ijfmr.2026.v08i02.71900>.

<sup>15</sup>Anna Arnaudo, Riccardo Coppola, Maurizio Morisio, Antonio Vettrò, M. Borghi, Riccardo Raso, and Bryan Khan, "Generative AI and Intellectual Property: A Systematic Literature Review of Possible Issues and Mitigations," *PeerJ Computer Science* (2026), <https://doi.org/10.7717/peerj-cs.3928>.

<sup>16</sup>Lucchi, "ChatGPT: A Case Study", op. cit.

<sup>17</sup>Jiahao Ni, "Intellectual Property Protection Dilemmas and Legal Response Strategies under the Perspective of Generative Artificial Intelligence,"

*Journal of Education, Humanities and Social Sciences* (2024), <https://doi.org/10.54097/8q8mfm80>.

<sup>18</sup>Chesterman, "Good Models Borrow, Great Models Steal", op. cit.

<sup>19</sup>Tornike Merebashvili, "Generative Artificial Intelligence: New Dilemmas for Intellectual Property Law," *Socrates: Rīga Stradiņš University Faculty of Law Electronic Scientific Journal of Law*, no. 205 (2025): 80–84, <https://doi.org/10.25143/socr.31.2025.1.80-84>.

<sup>20</sup>Thaler v. Perlmutter, op. cit.

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jurisdictions. Section 4 concludes with policy recommendations for legislators, courts, and creative industry stakeholders.

This article contributes to the existing literature in two respects. First, whereas much of the current scholarship addresses either the authorship problem or the training-data problem in isolation, this article treats the two as structurally linked manifestations of a single underlying difficulty: the mismatch between IP law's assumption of a discrete, identifiable, human creative act and the statistical, aggregative, and probabilistic character of generative AI systems.<sup>21</sup> Second, by situating the Indonesian legal framework under<sup>22</sup> within a broader comparative analysis spanning common-law and civil-law jurisdictions alike, this article seeks to contribute a perspective from a major developing-economy jurisdiction that has thus far received comparatively less sustained scholarly attention than the United States, the European Union, and China, notwithstanding the significant size and growth of Indonesia's own creative and digital economy sectors.<sup>23</sup>

## METHODOLOGY

This article employs a normative juridical (*yuridis normatif*) research method, which treats law as a coherent system of norms to be analyzed through the internal logic of

statutes, judicial decisions, and doctrinal scholarship rather than through empirical observation of social behavior.<sup>24</sup> The normative approach is appropriate for the research problem addressed here because the central inquiry concerns the proper interpretation and reform of existing legal categories — authorship, originality, inventorship, and infringement — rather than the measurement of an external social phenomenon. Three complementary approaches are used within this normative framework. The statutory approach (statute approach) examines primary legal instruments directly relevant to generative AI and IP protection, including national copyright and patent statutes such as<sup>25</sup>, regional instruments such as the<sup>26</sup>, and the doctrinal output of national copyright offices and patent authorities. The conceptual approach (conceptual approach) is used to analyze legal concepts that have not yet received settled statutory definition, most importantly the concept of "authorship" and the threshold of human creative control necessary to sustain a valid copyright claim over AI-assisted output.<sup>27</sup> The comparative approach (comparative approach) places multiple jurisdictions side by side — principally the United States, the European Union, the United Kingdom, China, India, and Indonesia — in order to identify convergences and divergences in regulatory strategy and to draw generalizable lessons that are not artifacts of any single legal tradition.<sup>28</sup>

<sup>21</sup>Kangyi Wang, Renfu Liu, Ruisheng Wang, B. Pang, and Tianlan Zhou, "Ethical Embedding and Institutional Reconstruction of Intellectual Property Governance for Generative Artificial Intelligence," Lecture Notes in Education Psychology and Public Media (2026), <https://doi.org/10.54254/2753-7048/2026.lid33864>.

<sup>22</sup>UU No. 28/2014 tentang Hak Cipta, op. cit.

<sup>23</sup>Mantiqa, Hayati, and Nugraha, "Generative AI in the Context of Intellectual Property Law", op. cit.

<sup>24</sup>Jiaheng Lu, "Challenges and Responses to Legal Protection of Intellectual Property in the Era of Artificial Intelligence," *Frontiers in Humanities and Social Sciences* (2026), <https://doi.org/10.54691/b27p2g97>.

<sup>25</sup>UU No. 28/2014 tentang Hak Cipta, op. cit.

<sup>26</sup>EU AI Act (Regulation (EU) 2024/1689), op. cit.

<sup>27</sup>Grishma Bhavsar, "Intellectual Property in the Age of Generative Artificial Intelligence: Rethinking the Legal Dimensions of Innovation and Protection," *Trends in Intellectual Property Research* (2025), <https://doi.org/10.69971/tipr.3.1.2025.87>.

<sup>28</sup>U. Ali, "Generative Artificial Intelligence and Intellectual Property Rights: Impacts, Challenges, and Future Directions," *UCP Journal of Law & Legal Education* (2025), <https://doi.org/10.24312/ucp-jlle.03.01.290>.

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Primary legal materials analyzed include relevant statutory provisions, administrative regulations, and judicial decisions, most notably the <sup>29</sup> line of cases concerning AI authorship in the United States. Secondary legal materials consist of peer-reviewed journal articles, working papers, and scholarly commentary published predominantly within the last five years, reflecting the fast-moving character of both the underlying technology and the legal responses to it. <sup>30</sup> Data collection was conducted through systematic review of legal databases, institutional repositories, and academic search engines, followed by qualitative content analysis in which recurring doctrinal themes — authorship attribution, training-data licensing, infringement liability, and regulatory design — were identified, coded, and synthesized into the discussion presented in Section 3. <sup>31</sup> The analysis further applies a policy-oriented evaluative method, assessing existing and proposed legal responses against the traditional justificatory goals of intellectual property law: incentivizing creative and inventive labor, ensuring fair reward and attribution, and preserving a robust public domain from which future innovation can draw. <sup>32</sup>

The scope of the research is deliberately comparative rather than confined to a single jurisdiction, reflecting the transnational character of generative AI development and deployment: a foundation model trained by a developer in one country is typically deployed as a service accessible to users worldwide, and outputs generated in one jurisdiction may infringe rights protected under the law of another. <sup>33</sup> This transnational structure means that purely domestic doctrinal analysis,

however rigorous, risks producing recommendations of limited practical value if they cannot be reconciled with the regulatory choices being made simultaneously by the small number of jurisdictions in which most major generative AI developers are headquartered. The comparative method adopted here is therefore intended not merely as an academic exercise in classification but as a necessary precondition for formulating policy recommendations, presented in Section 4, that are realistic in light of the cross-border regulatory dynamics actually shaping the generative AI industry. <sup>34</sup>

Limitations of the method should also be acknowledged. Because generative AI law is evolving rapidly, with new judicial decisions, administrative guidance, and legislative amendments issued on a near-continuous basis, any normative juridical analysis necessarily reflects a snapshot of the law as it stood at the time of writing rather than a permanent doctrinal settlement. <sup>35</sup> The analysis in Section 3 accordingly emphasizes underlying structural patterns and recurring doctrinal tensions likely to remain relevant even as specific rules continue to be refined, rather than attempting an exhaustive, real-time restatement of every applicable rule in every surveyed jurisdiction.

## RESULTS AND DISCUSSION

### *Authorship, Originality, and Ownership of AI-Generated and AI-Assisted Works*

The most doctrinally fundamental challenge posed by generative AI concerns the concept of authorship. Copyright law across virtually all jurisdictions has historically presupposed that a "work" originates from the intellectual creation of a natural person, whose

<sup>29</sup>Thaler v. Perlmutter, op. cit.

<sup>30</sup>Arnaudo et al., "Generative AI and Intellectual Property", op. cit.

<sup>31</sup>A. Hachkevych, "'Synthetic Creativity' of Generative Artificial Intelligence Poses Challenges for Legal Protection of Copyright and Related Rights," Visnyk of Lviv Polytechnic National University: Series of Legal Sciences (2025), <https://doi.org/10.23939/law2025.47.043>.

<sup>32</sup>Merebashvili, "New Dilemmas for Intellectual Property Law", op. cit.

<sup>33</sup>Fontana, "Intellectual Property Protection in the Era of Artificial Intelligence", op. cit.

<sup>34</sup>Taeihagh, "Governance of Generative AI", op. cit.

<sup>35</sup>Ziyin Zhou, "Intellectual Property Protection for Generative AI-Created Works: Challenges and Countermeasures in Administrative Penalty Discretionary Benchmarks," Legal Compliance (2026), <https://doi.org/10.63808/lc.v2i1.278>.

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personal choices regarding selection, arrangement, and expression give the resulting output the minimal originality required for protection.<sup>36</sup> Generative AI systems disrupt this presupposition because the expressive choices embodied in a generated output are substantially determined by the statistical parameters of a trained model rather than by the direct, continuous exercise of human judgment over each element of the final work.

The clearest judicial statement of the prevailing approach comes from the United States, where the<sup>37</sup> litigation addressed a copyright registration application for a visual artwork listing an AI system as the sole author, with the human applicant claiming ownership as a matter of machine ownership rather than personal authorship. The United States Copyright Office denied registration on the ground that copyright protection requires human authorship, and the District Court for the District of Columbia affirmed this position, holding that "human authorship is a bedrock requirement of copyright" under the governing statute.<sup>38</sup> The Court of Appeals for the District of Columbia Circuit subsequently affirmed on largely the same reasoning, and the Supreme Court declined to review the case, leaving the human-authorship requirement as settled law in the United States for the time being.<sup>39</sup> Comparable reasoning has been echoed by copyright authorities and commentators in other jurisdictions, suggesting an emerging, if not yet fully harmonized, international consensus that an AI system itself cannot be recognized as an author for copyright purposes.<sup>40</sup>

This consensus, however, resolves only the easiest case — a work generated with no human involvement whatsoever. It leaves unanswered the substantially harder and practically far more common question of how

much and what kind of human involvement is sufficient to support a valid copyright claim over a work that is AI-assisted rather than purely AI-generated.<sup>41</sup> A user who supplies a single short prompt to an image generator arguably exercises far less creative control than a user who iteratively refines dozens of prompts, edits AI-generated drafts extensively, selects among many generated variants, and combines AI output with substantial original human-authored material. Existing guidance from copyright offices, including registration guidance issued in the United States, has attempted to draw this line by focusing on whether the human user's contribution reflects the kind of "creative control" traditionally associated with authorship, as opposed to merely providing an idea or instruction that the AI system then executes autonomously.<sup>42</sup> Scholars have criticized this standard as unstable and difficult to apply consistently, since the boundary between an "instruction" and a "creative choice" is inherently a matter of degree rather than kind.<sup>43</sup>

Comparative analysis reveals meaningfully different doctrinal starting points across jurisdictions. Common-law jurisdictions that have historically recognized "computer-generated works" as a distinct statutory category — most notably the United Kingdom, whose Copyright, Designs and Patents Act attributes authorship of computer-generated works to "the person by whom the arrangements necessary for the creation of the work are undertaken" — appear better positioned to accommodate AI-assisted authorship without requiring wholesale doctrinal innovation, because the statutory category was designed decades ago with automated and semi-automated creation processes already in mind.<sup>44</sup> By contrast, civil-law systems and the United States, which

<sup>36</sup>Wang et al., "Ethical Embedding and Institutional Reconstruction", op. cit.

<sup>37</sup>Thaler v. Perlmutter, op. cit.

<sup>38</sup>Ibid., 142.

<sup>39</sup>Ibid.

<sup>40</sup>Asghar, "Artificial Intelligence and Intellectual Property Law", op. cit.

<sup>41</sup>Pakshin, "Criteria for the Legal Protection", op. cit.

<sup>42</sup>Fontana, "Intellectual Property Protection in the Era of Artificial Intelligence", op. cit.

<sup>43</sup>Bhavsar, "Intellectual Property in the Age of Generative Artificial Intelligence", op. cit.

<sup>44</sup>Chesterman, "Good Models Borrow, Great Models Steal", op. cit.

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anchor authorship more strictly in the personality and intellectual creation of a natural person, face a starker doctrinal choice between denying protection to substantially AI-generated works altogether or stretching the human-authorship requirement in ways that risk undermining its coherence.<sup>45</sup> Chinese courts and administrative practice have taken an intermediate and evolving position, in some instances extending protection to AI-assisted works where sufficient human creative input and control over the generative process can be demonstrated, reflecting a policy preference for incentivizing continued investment in AI-assisted content production within the domestic creative economy.<sup>46</sup>

Indonesian scholarship situates these debates within the framework of<sup>47</sup>, which similarly defines a "ciptaan" (work) by reference to the personal intellectual creativity of its creator, expressed in a tangible form.<sup>48</sup> Because the statute predates the generative AI era by a decade, it offers no explicit guidance on AI-assisted authorship, leaving Indonesian courts and the Directorate General of Intellectual Property to navigate the same authorship-threshold problem confronting other jurisdictions, but without the benefit of settled comparative precedent from courts operating under a closely analogous statutory text. Indonesian commentators have generally urged a cautious, human-centered interpretation consistent with the statute's original design, while acknowledging the practical difficulty of policing the human-contribution threshold in an environment of widespread, informal AI-assisted content creation across the national creative economy.<sup>49</sup>

A closely related but analytically distinct problem arises in patent law, where the requirement of a natural-person "inventor" has likewise been tested by AI systems capable of autonomously generating novel technical solutions.<sup>50</sup> Litigation concerning the "DABUS" AI system, which was listed as the sole inventor on patent applications filed in multiple jurisdictions, produced a broadly consistent judicial rejection of AI inventorship across patent offices and courts in the United States, the United Kingdom, the European Union, and Australia's intermediate appellate proceedings, on the ground that patent statutes uniformly presuppose a natural person capable of "conceiving" an invention.<sup>51</sup> Unlike the copyright context, however, patent law's traditionally higher threshold for inventive contribution — requiring a specific, identifiable conception of the solution to a technical problem — makes the line-drawing problem for AI-assisted inventorship in some respects more tractable than the corresponding copyright authorship question, since patent examination already involves detailed, claim-by-claim scrutiny of the inventive contribution.<sup>52</sup> Nevertheless, as AI systems are increasingly used not merely as tools but as active participants in hypothesis generation and experimental design within fields such as drug discovery and materials science, the pressure to recognize some form of AI-assisted or AI-facilitated inventorship, or alternatively to develop a *sui generis* protection regime for AI-generated technical outputs that fall outside conventional patentability criteria, is likely to intensify.<sup>53</sup>

<sup>45</sup>Merebashvili, "New Dilemmas for Intellectual Property Law", op. cit.

<sup>46</sup>Zhi Yang and Yuan-Yuan Xu, "Study on the Path of Generative Artificial Intelligence Copyright Protection under the Strategy of Intellectual Property Power," *Scientific Journal of Humanities and Social Sciences* (2024), <https://doi.org/10.54691/my07eq41>.

<sup>47</sup>UU No. 28/2014 tentang Hak Cipta, op. cit.

<sup>48</sup>Mantiqa, Hayati, and Nugraha, "Generative AI in the Context of Intellectual Property Law", op. cit.

<sup>49</sup>Ibid.

<sup>50</sup>Kandalai, "Algorithmic Ownership", op. cit.

<sup>51</sup>Asghar, "Artificial Intelligence and Intellectual Property Law", op. cit.

<sup>52</sup>Ni, "Intellectual Property Protection Dilemmas", op. cit.

<sup>53</sup>Zhou, "Intellectual Property Protection for Generative AI-Created Works", op. cit.

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The ownership question compounds the authorship question once a threshold of sufficient human creative or inventive contribution is met. Even where a human user is recognized as author or inventor, contractual terms of service imposed by AI platform operators frequently purport to allocate rights in generated output — sometimes granting the platform a broad license or even outright ownership, sometimes disclaiming any platform interest and vesting rights in the user, and sometimes leaving the allocation ambiguous in ways that generate downstream commercial uncertainty for businesses integrating generative AI into content production pipelines.<sup>54</sup> This contractual layer operates alongside, and sometimes in tension with, the underlying statutory allocation of rights, producing a further source of legal uncertainty that pure doctrinal analysis of authorship cannot resolve on its own and that instead requires attention to contract law, platform governance, and industry self-regulation.<sup>55</sup>

Taken together, the authorship, inventorship, and ownership problems examined in this subchapter demonstrate that generative AI does not so much break IP doctrine as expose latent ambiguities that were always present but rarely tested — how much human involvement is enough, how creative control should be evidenced, and how contractual allocation interacts with statutory default rules.<sup>56</sup> The comparative picture suggests that jurisdictions with pre-existing statutory categories for computer-generated or computer-assisted works are better equipped to absorb the shock of generative AI without wholesale doctrinal revision, while jurisdictions anchored in a strict personality-based conception of authorship, including Indonesia and the United States, face a more difficult reform path requiring either legislative

clarification or continued judicial improvisation on a case-by-case basis.<sup>57</sup>

A further complication concerns joint and collective authorship scenarios that are becoming increasingly common in professional creative practice, where a single final work may combine substantial human-authored material — an original screenplay, a hand-drawn character design, an edited musical composition — with discrete elements generated by AI tools, such as AI-generated background art, AI-assisted color grading, or AI-suggested dialogue variations later revised by a human editor.<sup>58</sup> Existing joint-authorship doctrine, developed for collaborations among multiple human contributors each capable of independently satisfying the originality requirement, does not map neatly onto collaborations between a human author and a non-authorial AI tool, since the AI's contribution cannot itself be independently copyrightable. Commentators have generally concluded that such hybrid works should be protected only to the extent of their human-authored components, with the AI-generated elements either excluded from protection or, where inextricably merged with protectable human expression, protected derivatively as part of the whole compilation, though the practical line-drawing this requires remains a significant source of registration and licensing uncertainty.<sup>59</sup>

Registration practice adds a further practical dimension to the authorship debate. Copyright offices in several jurisdictions now require applicants to disclose whether and how AI tools were used in producing a submitted work, and to specify which elements of the work reflect human authorship as distinct from

<sup>54</sup>Asghar, "Artificial Intelligence and Intellectual Property Law", *op. cit.*

<sup>55</sup>Fontana, "Intellectual Property Protection in the Era of Artificial Intelligence", *op. cit.*

<sup>56</sup>Pakshin, "Criteria for the Legal Protection", *op. cit.*

<sup>57</sup>Mantiqa, Hayati, and Nugraha, "Generative AI in the Context of Intellectual Property Law", *op. cit.*

<sup>58</sup>Arnaudo et al., "Generative AI and Intellectual Property", *op. cit.*

<sup>59</sup>Pakshin, "Criteria for the Legal Protection", *op. cit.*

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AI-generated content.<sup>60</sup> While such disclosure requirements are intended to operationalize the human-authorship threshold at the point of registration rather than leaving it entirely to post hoc litigation, they also impose new compliance burdens on applicants, who may find it genuinely difficult to characterize precisely which aspects of an iteratively AI-assisted creative process reflect their own original expression as opposed to the AI system's statistical output, particularly in creative workflows where human and machine contributions are interleaved many times before a final work is produced.<sup>61</sup>

### ***Training Data, Infringement Liability, and Regulatory Governance Responses***

The second major locus of legal difficulty concerns the lawfulness of the process by which generative AI models are trained, and the allocation of liability when trained models produce infringing outputs. Generative models acquire their capabilities by processing enormous datasets, frequently comprising billions of documents, images, and code fragments scraped from publicly accessible sources on the internet, a substantial proportion of which is protected by copyright and was not made available under a license authorizing use as AI training data.<sup>62</sup> This practice has triggered a wave of litigation in the United States and elsewhere brought by authors, visual artists, news publishers, and stock-image companies against major AI developers, alleging that unauthorized reproduction of copyrighted works for training purposes constitutes direct copyright infringement, and that AI-generated outputs which closely resemble or reproduce elements of specific training works constitute additional, output-side infringement.<sup>63</sup>

The central doctrinal battleground in the United States is the fair use defense under the

Copyright Act, which permits certain unauthorized uses of copyrighted works evaluated against four statutory factors: the purpose and character of the use, including whether it is transformative; the nature of the copyrighted work; the amount and substantiality of the portion used; and the effect of the use upon the potential market for the original work.<sup>64</sup> AI developers have argued that training a generative model is quintessentially transformative because the model does not store or retrieve copies of training works but instead learns abstract statistical patterns that are used to generate new, non-substitutive content. Rightsholders have countered that mass, unlicensed reproduction of entire copyrighted corpora is not transformative merely because the ultimate output differs from the input, and that the practice directly threatens the licensing markets and the economic incentives that copyright law is designed to protect, particularly where AI outputs can substitute for and depress demand for the works of the very authors whose material trained the system.<sup>65</sup>

Outside the United States, the predominant regulatory strategy has been the enactment or extension of statutory text-and-data-mining (TDM) exceptions, which permit certain reproductions of copyrighted works for the purpose of computational analysis, subject to conditions such as lawful access to the source material and, in some formulations, an opt-out mechanism allowing rightsholders to reserve their rights against TDM use.<sup>66</sup> The European Union's Digital Single Market Copyright Directive established such an exception, and the subsequent<sup>67</sup> layered additional obligations onto general-purpose AI model providers, including requirements to maintain and make publicly available a sufficiently detailed summary of the content used for training, and to implement policies respecting rightsholders'

<sup>60</sup>Fontana, "Intellectual Property Protection in the Era of Artificial Intelligence", op. cit.

<sup>61</sup>Bhavsar, "Intellectual Property in the Age of Generative Artificial Intelligence", op. cit.

<sup>62</sup>Lucchi, "ChatGPT: A Case Study", op. cit.

<sup>63</sup>Samuelson, "Generative AI Meets Copyright", op. cit.

<sup>64</sup>Ibid.

<sup>65</sup>Lucchi, "ChatGPT: A Case Study", op. cit.

<sup>66</sup>Fontana, "Intellectual Property Protection in the Era of Artificial Intelligence", op. cit.

<sup>67</sup>EU AI Act (Regulation (EU) 2024/1689), op. cit.

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TDM opt-out reservations.<sup>68</sup> This transparency-plus-opt-out architecture represents a middle path between the largely permissive U.S. fair use approach and a strict prior-licensing requirement, though critics note that the practical efficacy of opt-out mechanisms depends heavily on machine-readable standardization and robust enforcement, neither of which is yet fully mature.<sup>69</sup>

China has pursued a more directly administrative regulatory model, requiring providers of generative AI services made available to the public to comply with algorithm registration and security assessment obligations, content labeling requirements for AI-generated material, and general obligations to respect intellectual property rights in training data sourcing, enforced through the Cyberspace Administration of China and related regulatory bodies rather than through copyright litigation alone.<sup>70</sup> This approach reflects a broader governance philosophy in which generative AI is treated as a matter of state oversight and public-interest regulation from the outset, rather than being left primarily to private civil litigation between rightsholders and developers, a distinction that Chinese commentators have linked to the country's strategic ambitions in AI industrial policy alongside its stated commitment to intellectual property protection.<sup>71</sup> Indian scholarship has documented a comparable tension between fostering a nascent domestic generative AI industry and protecting the country's substantial creative and cultural production sectors, with commentators generally favoring incremental adaptation of the existing Copyright Act framework, including its fair dealing provisions, over wholesale legislative replacement.<sup>72</sup>

A further dimension of the training-data problem concerns memorization and output-side infringement: the empirically documented phenomenon whereby generative models, particularly when trained on data containing many near-duplicate copies of a given work, can reproduce substantial verbatim or near-verbatim excerpts of specific training documents in response to certain prompts.<sup>73</sup> This phenomenon complicates the developers' transformative-use defense, because it demonstrates that at least some outputs are not merely inspired by statistical patterns abstracted from the training corpus but can constitute direct, output-level reproduction of protectable expression from an identifiable source work. Commentators have accordingly argued for a bifurcated liability analysis that treats the legality of the training process and the legality of specific generated outputs as analytically separate questions, each subject to its own infringement analysis, rather than allowing a favorable ruling on one issue to resolve the other by implication.<sup>74</sup>

Liability allocation among the multiple actors involved in the generative AI supply chain — model developers, platform deployers who fine-tune or integrate a base model into a consumer-facing product, and end users who supply prompts and select among generated outputs — remains one of the least settled aspects of current doctrine.<sup>75</sup> Traditional secondary liability doctrines, such as contributory and vicarious infringement in U.S. copyright law, were developed in the context of technologies such as peer-to-peer file-sharing networks and photocopying services, where the infringing act and the facilitating technology were more clearly separable than they are in the generative AI context, where the same underlying model simultaneously enables both overwhelmingly non-infringing and

<sup>68</sup>Taeihagh, "Governance of Generative AI", op. cit.

<sup>69</sup>Arnaudo et al., "Generative AI and Intellectual Property", op. cit.

<sup>70</sup>Zhang and Huang, "Legal Risks and Governance Approaches", op. cit.

<sup>71</sup>Wang et al., "Ethical Embedding and Institutional Reconstruction", op. cit.

<sup>72</sup>Vig, "Intersection of Generative Artificial Intelligence and Copyright", op. cit.

<sup>73</sup>Lucchi, "ChatGPT: A Case Study", op. cit.

<sup>74</sup>Chesterman, "Good Models Borrow, Great Models Steal", op. cit.

<sup>75</sup>Asghar, "Artificial Intelligence and Intellectual Property Law", op. cit.

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occasionally infringing uses.<sup>76</sup> Several commentators have proposed graduated liability frameworks that assign primary responsibility to developers for training-data sourcing decisions, assign responsibility to deploying platforms for implementing reasonable output-filtering and content-moderation safeguards, and reserve direct end-user liability for cases involving knowing or willful circumvention of such safeguards to generate infringing content deliberately.<sup>77</sup> Such graduated approaches echo, without directly replicating, the notice-and-takedown and safe-harbor architectures developed for online intermediary liability in earlier generations of internet regulation, adapted to account for the distinctive risk profile of generative rather than merely hosting or transmitting technologies.<sup>78</sup>

Beyond copyright, generative AI raises analogous but distinct risks under trademark and personality-rights-adjacent doctrines, particularly where models can be prompted to generate content mimicking a living artist's distinctive style, a celebrity's voice or likeness, or a brand's protected trade dress, without producing a literal reproduction of any single copyrighted work and therefore without triggering conventional copyright infringement analysis at all.<sup>79</sup> Existing trademark doctrine, centered on likelihood of confusion as to source or sponsorship, and right-of-publicity doctrines, which vary considerably across jurisdictions and in several U.S. states exist only as an evolving patchwork of common law and statute, provide at best partial and unevenly available protection against such style-mimicry and identity-appropriation harms, prompting proposals for new or extended sui generis rights specifically addressing AI-enabled style and likeness replication.<sup>80</sup>

Emerging governance responses increasingly favor a combination of instruments rather than reliance on any single regulatory lever: statutory TDM exceptions calibrated with opt-out and transparency obligations to address the training-data legality question; clarified authorship and inventorship thresholds, whether through legislation or accumulated judicial precedent, to address the ownership question; graduated, role-differentiated liability rules to address the output-infringement question; and dedicated administrative oversight mechanisms, of the kind pioneered in China and increasingly contemplated within the EU's broader AI Act architecture, to enable more proactive and less purely reactive regulation of a technology whose risks are difficult to fully anticipate through litigation alone.<sup>81</sup> For developing economies such as Indonesia, where the creative and technology sectors are both significant contributors to economic growth, the comparative evidence surveyed in this subchapter suggests that early legislative clarification — rather than prolonged reliance on judicial improvisation under a copyright statute never designed with generative AI in mind — would reduce legal uncertainty for both domestic creators seeking protection and the growing domestic AI development sector seeking a predictable operating environment.<sup>82</sup>

The governance responses surveyed above also carry important implications for smaller and independent creators, who typically lack the resources to pursue protracted litigation against well-resourced AI developers even where a plausible infringement claim exists.<sup>83</sup> Collective licensing arrangements, administered by copyright collecting societies empowered to negotiate on behalf of large groups of rightsholders, have been proposed as

<sup>76</sup>Ni, "Intellectual Property Protection Dilemmas", op. cit.

<sup>77</sup>Zhou, "Intellectual Property Protection for Generative AI-Created Works", op. cit.

<sup>78</sup>Kandalai, "Algorithmic Ownership", op. cit.

<sup>79</sup>Hachkevych, "'Synthetic Creativity' of Generative Artificial Intelligence", op. cit.

<sup>80</sup>Merebashvili, "New Dilemmas for Intellectual Property Law", op. cit.

<sup>81</sup>Taeihagh, "Governance of Generative AI", op. cit.

<sup>82</sup>Mantiqa, Hayati, and Nugraha, "Generative AI in the Context of Intellectual Property Law", op. cit.

<sup>83</sup>Hachkevych, "'Synthetic Creativity' of Generative Artificial Intelligence", op. cit.

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a more accessible alternative to individual litigation, potentially allowing creators to obtain compensation for the use of their works as training data without bearing the full cost and evidentiary burden of proving infringement on an individual basis.<sup>84</sup> Several jurisdictions already possess collecting-society infrastructure originally developed for broadcasting and public-performance royalties that could plausibly be extended, with appropriate statutory authorization, to cover AI-training licensing, offering a potentially faster path to functional reform than waiting for comprehensive new legislation in every jurisdiction.<sup>85</sup>

Platform-level technical measures constitute a complementary, non-litigation-based governance layer. Content-provenance standards that embed verifiable metadata into AI-generated outputs, machine-readable opt-out signals that AI crawlers are expected to respect when harvesting training data, and automated output-filtering systems designed to detect and block near-verbatim reproduction of identifiable copyrighted material before an output is delivered to an end user, together illustrate how technical infrastructure can operationalize legal obligations that would otherwise be difficult to enforce through litigation alone.<sup>86</sup> The effectiveness of such measures nonetheless depends on industry-wide adoption and interoperability, which in turn depends on a degree of regulatory encouragement or mandate that, to date, only a small number of jurisdictions have begun to provide.<sup>87</sup>

## CONCLUSION

Generative artificial intelligence has exposed three interlocking fault lines in contemporary intellectual property law: the uncertain threshold of human contribution required to sustain authorship or inventorship

over AI-assisted works; the contested legality of using copyrighted material as unlicensed training data; and the unresolved allocation of liability for infringing outputs among developers, deploying platforms, and end users.<sup>88</sup> Comparative analysis across the United States, the European Union, China, India, and Indonesia reveals a shared underlying diagnosis but markedly different regulatory prescriptions: the United States has relied primarily on judicial interpretation of existing fair use and authorship doctrine, exemplified by; the European Union has adopted an intermediate transparency-and-opt-out model embedded in the; China has pursued direct administrative oversight of generative AI services; and India and Indonesia are each in earlier, more exploratory stages of adapting existing copyright frameworks such as to the generative AI context.

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<sup>84</sup>Merebashvili, "New Dilemmas for Intellectual Property Law", op. cit.

<sup>85</sup>Yang and Xu, "Study on the Path of Generative Artificial Intelligence Copyright Protection", op. cit.

<sup>86</sup>Arnaudo et al., "Generative AI and Intellectual Property", op. cit.

<sup>87</sup>Taeihagh, "Governance of Generative AI", op. cit.

<sup>88</sup>Fontana, "Intellectual Property Protection in the Era of Artificial Intelligence", op. cit.

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