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Innovation And Regulation: Legal Challenges In Indonesia In Responding To The Development Of Generative Artificial Intelligences

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Abstract
This study analyzes the legal challenges in balancing Generative AI (GenAI) innovation and regulatory needs in Indonesia, identifies regulatory gaps, sectoral impacts, and formulates policy recommendations based on the principles of justice and sustainability. Method:Research usingqualitative literature studywith a descriptive-analytical approach. The study identifiesthree main challenges: (1) Non-adaptive regulation, where the ITE, PDP, and Copyright laws fail to regulate crucial aspects of GenAI such as the legal status of AI output, algorithm bias, and use of training data; (2)Ambiguous threshold of accountability, making it difficult to determine who is responsible for illegal content or AI-based disinformation; and (3)Sectoral impacts were not anticipated, including riskshallucinationin the financial sector, educational plagiarism, and disruption of the creative workforce. Proposed solutions includerisk-based regulation, amendments to the Copyright Act for AI creations, collaborationmultistakeholder, And regulatory sandboxfor controlled innovation.

Abstrak
Penelitian ini menganalisis tantangan hukum dalam menyeimbangkan inovasi Generative AI (GenAI) dan kebutuhan regulasi di Indonesia, mengidentifikasi celah regulasi, dampak sektoral, serta merumuskan rekomendasi kebijakan berbasis prinsip keadilan dan keberlanjutan. Metode: Penelitian menggunakan studi pustaka kualitatif dengan pendekatan deskriptif-analitis. Studi mengidentifikasi tiga tantangan utama: (1) Regulasi yang tidak adaptif, di mana UU ITE, PDP, dan Hak Cipta gagal mengatur aspek krusial GenAI seperti status hukum output AI, bias algoritma, dan penggunaan data pelatihan; (2) Ambang akuntabilitas yang ambigu, menyulitkan penentuan pihak bertanggung jawab atas konten ilegal atau disinformasi berbasis AI; serta (3) Dampak sektoral tidak terantisipasi, termasuk risiko hallucination di sektor keuangan, plagiarisme pendidikan, dan disrupsi tenaga kerja kreatif. Solusi yang diusulkan mencakup regulasi berbasis risiko, amandemen UU Hak Cipta untuk ciptaan AI, kolaborasi multistakeholder, dan regulatory sandbox untuk inovasi terkendali.

Kata Kunci : Inovasi dan Regulasi, Hukum di Indonesia, Perkembangan Generatif AI

INTRODUCTION

Indonesia, as a dynamic nation, continues to grapple with the challenges of creating a responsive, effective, and equitable legal system (Hanisa and Firdaus, 2023). In recent decades, especially post-Reformation, the wave of legal regulatory innovation has become an important pulse in efforts to realize these goals. This innovation was not born out of a vacuum, but rather is a response to the demands of the complexity of the times, the demands of globalization, and the aspirations of the community for better public services and a conducive business climate. The essence is to make breakthroughs in the way of thinking and acting in designing, implementing, and evaluating laws and regulations.

One of the significant breakthroughs lies in the efforts to harmonize and synchronize regulations (Aryani, 2021). The shadow of the past, where overlaps and contradictions between regulations from the central to regional levels became a source of confusion and conflict, is slowly starting to be dispelled. Systematic efforts are being made to align regional regulations with central regulations, as well as to ensure coherence between sectors. This step is not merely administrative, but a foundation for creating

legal certainty and preventing the public and business actors from the trap of uncertainty due to conflicting regulations.

In the field of business licensing and public services, innovation comes in the form of a digital revolution. The birth of the Online Single Submission (OSS) system is an important milestone, transforming the licensing process which was previously complicated, time-consuming, and prone to distortion into a more centralized, transparent, and efficient online process. The principle of a "risk-based approach" has begun to be applied, where the level of supervision is adjusted to the level of business risk, reducing the burden on micro and small businesses. Other public services, from population administration to taxation, have also experienced acceleration and simplification through digital platforms, bringing the state closer to its people.

Responding to complaints about the "regulatory burden" that hampers investment and competitiveness, the government launched a radical innovation through the Omnibus Law concept. The Job Creation Law, despite being hotly debated, is a massive experiment in simplifying dozens of overlapping laws into a more unified legal framework. The goal is clear: to cut through the long-winded bureaucratic chains, eliminate irrelevant or obstructive regulations, and create a more investment-friendly legal ecosystem for job creation, without neglecting environmental and worker protection.

Innovation has also penetrated the judicial realm. Courts are starting to leave behind their closed and slow image by adopting information technology (FIRDAUS, 2023). The e-Court, e-Filing, and e-Summons systems speed up the trial process and increase accessibility. Transparency is increased through the publication of court decisions online, allowing for public oversight and becoming a source of legal learning. Strengthening alternative dispute resolution institutions, such as arbitration and mediation, is also part of the innovation to reduce the burden on the courts and provide a faster and more flexible resolution path for the parties.

No less important is innovation in law enforcement and corruption eradication. The establishment of special institutions such as the Corruption Eradication Commission (KPK), despite its complex dynamics, shows a commitment to handling corruption crimes in a more focused and independent manner. The approach to law enforcement is shifting from being merely reactive and repressive to being more preventive, for example through community empowerment and legal awareness campaigns. The use of digital technology is also utilized to detect criminal acts, such as in cases of money laundering and cybercrime.

The role of civil society in the regulatory process is also increasingly accommodated as a form of participatory innovation. Online and offline public consultation mechanisms, openness in the formation of Draft Laws (RUU), and the use of social media as a feedback channel, are becoming more common. This allows the aspirations and real needs of the community to be heard more in the legislative process, although the challenge of ensuring inclusive and meaningful participation is still being pursued.

At the implementation level, the "smart regulation" approach is starting to be echoed. This means that regulations are not only well-designed, but also consider cost-effectiveness, socio-economic impacts, and ease of implementation (Faiz and SH, 2009). Regulatory Impact Assessment (RIA) is increasingly required to ensure that a regulation is truly necessary and provides greater benefits than the costs it incurs. Periodic evaluations of old regulations are also carried out to revoke or revise regulations that are no longer relevant.

Innovation also touches on aspects of strengthening law and Human Rights (HAM). Ratification of various international conventions, drafting of the Bill on the Elimination of Sexual Violence, and efforts to improve protection for vulnerable groups such as children, people with disabilities, and indigenous peoples, demonstrate efforts to align the national legal framework with international human rights standards. Although implementation in the field is often faltering, this normative commitment is an important step. However, the path to legal regulatory innovation in Indonesia is not free from obstacles. Disparities in the capacity of local governments, resistance from bureaucracies accustomed to old ways, challenges of digital infrastructure in remote areas, and the complexity of coordination between institutions often slow down or even distort the implementation of policy innovation. In addition, maintaining a balance between ease of doing business, environmental protection, and workers' rights within a simplified regulatory framework remains a tricky homework.

Overall, the movement of legal regulatory innovation in Indonesia is an ongoing narrative, full of experiments, achievements, and challenges. From harmonization to digitalization, from simplification to public participation, every breakthrough is an effort to weave a legal system that is more adaptive, fair, and capable of being a vehicle for the nation's progress, although the journey towards perfection is still long and requires consistency and commitment from all stakeholders.

METHOD

The initial research began with the identification and formulation of key questions that became the focus: What are the dynamics of the tension between generative AI technology innovation and regulatory needs in Indonesia? What are the specific legal challenges that arise? The first step is to map the broad scientific field, searching for core literature in three main areas: (1) Generative AI Technology Studies (characteristics, potential, ethical/social risks such as bias, disinformation, intellectual property rights); (2) Technology and Innovation Regulation Theory (the concept of "regulatory sandbox", "principles of smart regulation", the challenge of "speed of law vs. speed of innovation"); and (3) Relevant Indonesian Legal Landscape (framework of PDP Law, ITE Law, Copyright Law, Artificial Intelligence Bill, and sectoral policies such as in finance with OJK). This process involves systematic searches in legal databases (e.g., JDIH, IJN), academic journals of law/technology (both national such as "Pandecta", "Masalah-Masalah Hukum", and international), think tank reports (e.g., CSIS, LPEM FEB UI), and official policy documents of the government/DPR RI Commission.

After the conceptual field was mapped, intensive and selective collection of literature sources was carried out. Selection criteria included relevance (directly discussing generative AI, technology regulations, or related Indonesian laws), topicality (priority of sources published in the last 3-5 years, considering the rapid development of AI), and credibility (peer-reviewed sources, publications from official institutions, works of experts in the field). The "snowballing" technique (tracking references from primary sources) was used to find key literature that might have been missed. The analysis stage involved critical reading and thematic synthesis.

The final stage of the literature study method is an in-depth contextualization of Indonesia's legal challenges based on literature synthesis. This means not only presenting global/theoretical findings, but critically situating them within Indonesia's socio-legal realities. It examines how the unique characteristics of the legal system (e.g. bureaucratic complexity, disparity in law enforcement capacity, controversial ITE Law framework, legislative political dynamics) affect the ability to respond to generative AI challenges. The synthesis is conducted to answer the research questions by building coherent arguments about: (1) The specific nature of the legal challenges facing Indonesia (e.g. regulating deepfakes under the multi-interpretable ITE Law, protecting AI model training data under the PDP Law, determining copyright authorship over AI output); (2) The main tensions between encouraging digital economy innovation and fulfilling public/human rights protection mandates; (3) The suitability and limitations of existing or proposed regulatory approaches (such as the AI Bill) in the literature to Indonesia's needs. This process results in a comprehensive yet critical understanding of the complexity of the legal challenges at the intersection of generative AI innovation and regulation in Indonesia, and identifies priority areas for policy development and further research.

RESULTS AND DISCUSSION

After the Proclamation of Independence in 1945, the biggest challenge was to build the country from scratch. The initial regulations were emergency and transitional, adopting and adapting Dutch colonial legacy regulations to fill the legal gap. The 1945 Constitution became the constitutional basis, but its implementation was still very basic (Thalib and Sh, 2018). The main focus was on consolidating power, national security, and regulating the central government. Innovation was limited due to the revolutionary situation and lack of resources; regulations were more reactive to urgent problems such as war and regional unrest.

Under Soeharto's leadership, the legal and regulatory system was built with the main goal of political stability and guided economic growth. The main characteristics are the centralization of power and executive dominance. The formation of laws is often top-down and highly controlled by the government. Many strong sectoral laws (such as the PMA Law, the Mining Law) emerged to attract

investment, but often ignored public participation and sustainability aspects. "Rule by Law" became its characteristic, where the law became a tool for legitimizing power and strict social control, not merely enforcing justice. Regulatory innovation was very minimal, except in terms of creating a framework for centralized economic development.

The fall of the New Order opened the door wide for fundamental legal and regulatory reform. The amendment to the 1945 Constitution (1999-2002) was the most important turning point, affirming the principles of democracy, the supremacy of law, human rights, regional autonomy, and the separation of powers. Many laws produced by the New Order that were considered undemocratic were revoked or revised (e.g. the Law on Political Parties, the Law on Elections). The birth of the Law on Regional Government (No. 22/1999, revised to No. 32/2004) shifted the paradigm from centralization to decentralization through regional autonomy. The main innovation lies in the effort to democratize the process of making regulations and restructuring the state system.

This era focuses on creating a more orderly and participatory legal framework for the formation of regulations themselves (Astomo, 2014). The birth of Law No. 10 of 2004 concerning the Formation of Legislation (later revised to Law No. 12 of 2011) became a crucial milestone. This law establishes a clear hierarchy of regulations (from the Constitution to the Village Regulations), requires Academic Manuscripts, and regulates the procedures for the formation of more transparent regulations, including public participation through public consultation and testing. Regulatory innovation shifted to the process: how to make good regulations (good regulatory practices) procedurally.

The accumulation of regulations over decades has created problems of overlap, contradiction and complexity that hamper investment and public services (Rohmah*et al.*, 2025). The Joko Widodo government has proposed the Omnibus Law concept as a major innovation. The goal is to simplify and revise dozens or even hundreds of laws at once through one umbrella law. The Job Creation Law (No. 11 of 2020) is the first manifestation of this concept, although it has drawn controversy regarding the ratification process and its substance. The innovation here is a major deregulation and regulatory reform approach to increase ease of doing business and competitiveness.

The digital revolution has forced the acceleration of regulatory innovation. Special laws have emerged to regulate cyberspace, such as the Electronic Information and Transactions Law (ITE - No. 11/2008, amended No. 19/2016) which regulates online transactions, digital signatures, and digital content (although its rubber articles have been widely criticized). Regulation of the fintech sector (POJK from OJK), e-commerce, personal data protection (the long-awaited PDP Bill), and other digital economies are growing rapidly. Regulatory innovation focuses on creating legal certainty in the dynamic cyberspace, balancing innovation with consumer protection and privacy.

Responding to complaints about the complexity and length of licensing, innovation is carried out through a risk-based approach (Low, Medium-Low, Medium-High, High) which is regulated in Government Regulation (PP) No. 24 of 2018 (as a derivative of the Job Creation Law). Low-risk businesses require almost no licensing (only NIB), while the focus of supervision is on high risk. This innovation is fully supported by the Online Single Submission (OSS) digital platform which is a single door for business licensing nationally. The goal is efficiency, convenience, and transparency in starting and running a business.

Decentralization has resulted in the proliferation of overlapping Regional Regulations (Perda), which conflict with higher regulations, or which hinder the economy. Innovation is carried out through the evaluation and harmonization mechanism of Perda by the Ministry of Home Affairs and the establishment of a Task Force for the Prevention of Problematic Perda. The aim is to ensure that Perda is in line with the Law, does not hinder investment, and protects public interests. The quality standards of regional regulations are improved through guidelines and technical assistance.

To accommodate new business model innovations (such as fintech, startup ecosystems, green economy) that do not yet have a clear regulatory framework, the concept of Regulatory Sandbox was introduced. OJK (for fintech) and Kemenkominfo (for digital) became pioneers. Sandbox allows testing of innovative products/services in limited markets with temporary relaxation of certain rules, under the supervision of regulators. This is an innovation in the adaptive regulation approach that is more flexible in responding to rapid changes.

Indonesia's regulatory innovation has undergone a significant transformation, from centralized to more democratic and adaptive, driven by technology. The main challenges now are: The speed of regulation making is still slow in the face of disruption; Coordination between ministries/institutions/regional governments is often weak, causing overlap; Substantial quality that is sometimes still problematic (multi-interpretable, not implementable); and Consistent Law Enforcement. Future innovations need to focus on stronger regulatory impact assessments, data-based cross-sector coordination, increasing the capacity of legislators and regulators, and ensuring that regulations are not only efficient but also fair, inclusive, and environmentally and socially sustainable. Technologies such as AI are also starting to be considered to assist in the analysis and preparation of regulations (regulatory technology or RegTech). This narrative describes the evolution from the formation of an emergency foundation, through a period of tight control, to an era of reform that emphasizes democratization, simplification, digitalization, and a more adaptive approach, with various challenges that still need to be overcome to create a regulatory ecosystem that truly supports Indonesia's progress.

Artificial Intelligences in Indonesian Legal Review

The rapid development of Artificial Intelligence (AI) has penetrated various sectors of life in Indonesia, from financial and health services to transportation and entertainment (Mahendra*et al.*, 2024). However, Indonesia's current legal landscape does not yet have a specific framework that comprehensively regulates the existence and operation of AI. Existing regulations are still scattered and reactive, relying on the application of general law and sectoral laws that are not explicitly designed to address the unique complexities of artificial intelligence systems. This creates significant challenges in providing legal certainty for developers, service providers, users, and the wider community affected by them.

The main basis for general technology regulation in Indonesia can be found in the Electronic Information and Transactions Law (UU ITE) (Hanisa and Firdaus, 2023). Although the ITE Law provides an important foundation regarding electronic transactions, digital signatures, dispute resolution, and personal data protection (before the PDP Law), its provisions do not specifically accommodate the technical characteristics and ethical-legal implications of AI systems, such as autonomous decision-making, algorithmic bias, or liability for errors produced by machines. Regulations regarding personal data now have a stronger legal umbrella through Law Number 27 of 2022 concerning Personal Data Protection (UU PDP), which has crucial implications for the development and implementation of AI that relies heavily on massive data processing.

In the realm of legal liability, ambiguity is a major issue. If a decision or action produced by an AI system causes loss, damage, or violation of the law, it is difficult to determine who is legally responsible under conventional legal frameworks such as the Civil Code (KUHPer) or the Criminal Code (KUHP) (Hernawan, Antow and Sendow, 2025). Does the responsibility fall to the algorithm developer, the training data owner, the platform provider, the end user who utilizes AI, or even the AI system itself as an autonomous entity? The absence of specific rules creates uncertainty and potential injustice in dispute resolution.

The intellectual property rights (IPR) aspect also faces challenges. Fundamental questions such as whether works produced autonomously by AI can be protected by copyright, or who owns the copyright, whether the programmer, user, system owner, or none at all, have not been fully answered in Indonesian IPR legislation (Fauzy, 2023). Likewise with patents, difficulties arise in patenting inventions produced by AI or in assessing the level of human contribution required to meet the requirements of novelty and inventive step. Current IPR regulations do not yet recognize AI as a creator or inventor.

Consumer protection is another important area. The use of AI in customer service, credit scoring, recruitment, or dynamic pricing can potentially lead to undetected discriminatory bias, minimal transparency, and difficulty in obtaining explanations for decisions that affect consumers. While the Consumer Protection Law regulates transparency of information and prohibits misleading practices, its application to the context of AI “black box” algorithms requires further interpretation and adjustment of technical regulations to ensure that consumer rights are effectively protected.

The Indonesian government itself has begun to show awareness of the urgency of AI regulation. Initiatives such as Presidential Regulation Number 39 of 2019 concerning One Data Indonesia and the preparation of the 2020-2045 National Strategy for Artificial Intelligence mark the first steps in directing the development and utilization of AI in a more structured and ethical manner. The National Strategy for AI, although not yet legally binding, emphasizes the importance of ethical aspects, security, privacy, and human resource readiness, which can be a basis for the preparation of further regulations. Standardization bodies such as BSN have also begun to develop Indonesian National Standards related to AI.

In response to these dynamics, various stakeholders, including academics, legal practitioners, civil society organizations, and technology industry associations, continue to encourage intensive discussions and in-depth studies to formulate an appropriate AI legal framework for Indonesia. The expected framework must be able to balance encouraging innovation and digital economic growth by ensuring the protection of human rights, justice, accountability, transparency, security, and privacy. An adaptive and risk-based regulatory approach is considered necessary to keep up with the very rapid pace of technological development.

Moving forward, Indonesia needs to carefully consider the regulatory model to be adopted, whether by creating a specific law on AI, revising existing sectoral laws to accommodate aspects of AI, or a combination of both. The establishment of a regulatory body that has the technical capacity to understand and oversee AI systems is also an important topic of discussion. Close collaboration between government, industry, academia, and civil society is key to designing a legal ecosystem that supports the responsible and sustainable use of AI in Indonesia. Without a clear and futuristic legal framework, AI's great potential to advance the nation is at risk of being hampered by uncertainty and the potential for unmanaged negative impacts.

Legal Challenges in Indonesia Addressing AI Advances

Gaping Speed Gap: The pace of AI innovation and adoption in Indonesia is far outstripping the ability to develop comprehensive regulations. Existing regulations, such as the ITE Law and the PDP Law, are designed for a more traditional digital context and do not adequately anticipate the technical complexities and ethical-social implications of autonomous, self-learning, decision-making AI systems (Herlina Ratna, 2025). The often lengthy and tortuous legislative process has not kept pace with the dynamics of technological development, creating a significant legal vacuum in many areas of AI application.

Definitional and Scope Ambiguity: Indonesia does not yet have a clear, uniform, and widely accepted legal definition of what constitutes “Artificial Intelligence” or “autonomous” systems. This lack of operational definition creates legal uncertainty. Emerging regulations risk being too narrow (thus excluding new forms of AI) or too broad (thus burdening innovations that are not at risk). Determining the boundaries of what is regulated as “AI” and what is still traditional software is a fundamental challenge. Confusion of Legal Accountability (Liability): Who is legally responsible when an AI system causes harm? Is it the algorithm developer, the training data owner, the system integrator, the end user, or even the “AI” itself (which is currently not recognized as a legal subject)? The traditional legal concept of fault and responsibility attached to humans or legal entities becomes very complicated to apply to systems whose decisions are difficult to trace (black box) and influenced by many parties. Cases such as AI misdiagnosis in health, autonomous vehicle accidents, or algorithmic discrimination in the financial sector require a clear accountability framework.

AI training and operations rely on massive amounts of data, often personal and sensitive (Hanisa and Firdaus, 2023). Although the PDP Law has been passed, its effectiveness in the context of AI is still being tested. Crucial issues include: the legal basis for data processing for AI training, the validity of consent when the use of the data is not fully predictable, effective data minimization in data-hungry systems, and preventing the use of data for mass surveillance or behavioral manipulation that violates individual privacy and autonomy. Compliance monitoring is also becoming more difficult.

Law Enforcement Capacity and Technical Understanding: Law enforcement officials (judges, prosecutors, police) and legislators often have limited technical understanding of how AI works, its

potential risks, and its legal implications (Kamila, 2025). These limitations hamper their ability to: (1) Create targeted and effective regulations, (2) Investigate violations involving AI effectively, (3) Handle complex digital evidence related to AI, and (4) Decide cases with a deep understanding of the technology at issue. Continuous capacity building is absolutely necessary.

Unclear Intellectual Property Rights (IPR) Protection: AI raises new questions in the IPR realm. Who owns the works (art, music, text, code) produced by AI? Can AI be considered an "inventor" so that a patent is granted? How to protect the AI algorithm itself (copyright, patent, or trade secret)? How to prevent large-scale IPR infringement by AI trained with unauthorized data? The existing Indonesian IPR framework is not designed to answer these complex questions, potentially stifling innovation or creating injustice.

Socio-Economic Impacts and Labor Protection: AI-based automation has the potential to significantly replace human jobs in various sectors. Indonesia does not yet have mature policies or regulations to anticipate this labor market disruption, such as massive reskilling/upskilling programs, adaptive social security, or taxes on automation. Labor regulations also need to be adjusted to regulate human-AI collaboration, workers' rights in algorithmic management, and prevent AI-based discrimination in recruitment and promotion.

The Need for a Binding Ethical Framework: Responsible development and use of AI requires a strong ethical foundation (e.g., fairness, transparency, accountability, privacy, non-discrimination). The challenge is how to translate these abstract ethical principles into enforceable technical standards and legal requirements (hard law), rather than just voluntary guidelines (soft law). Creating mechanisms for AI audits, explainability standards, and bias testing are crucial but difficult to legislate.

Cybersecurity Vulnerabilities and Abuse: AI systems themselves can become targets for cyberattacks (e.g., poisoning training data, stealing models) or tools for more sophisticated attacks (deepfakes for fraud or blackmail, mass disinformation, automated cyberattacks). Existing cybersecurity regulations need to be strengthened specifically to address the unique vulnerabilities introduced by AI and to punish its misuse that could threaten national stability, public security, and democracy.

Innovation vs. Regulation: The biggest overall challenge is to design regulations that do not stifle innovation and the enormous potential benefits of AI for Indonesia's economy and development, while still managing its risks effectively and protecting citizens' basic rights. A regulatory approach that is too strict and rigid could leave Indonesia behind. Conversely, a laissez-faire approach risks creating social harm and injustice. Finding a regulatory model that is adaptive, risk-based, collaborative (involving multi-stakeholders), and perhaps a regulatory sandbox is key to addressing these complex legal challenges while capitalizing on the opportunities that AI offers. In short, Indonesia faces multidimensional legal challenges in addressing AI, ranging from regulatory lags, conceptual ambiguities, accountability complexities, to the urgent need for capacity building and a balance between innovation and protection. Building a robust, adaptive, and ethically informed legal framework is not only a necessity, but a must to ensure that AI advances provide inclusive and sustainable benefits to the nation.

CONCLUSION

The development of Generative Artificial Intelligence (AI) brings great opportunities for innovation in Indonesia, but also complex legal challenges. Without clear regulations, this technology is at risk of being used for misuse, copyright infringement, or the spread of disinformation. Indonesia needs to immediately formulate an adaptive legal framework, combining data protection, accountability of AI developers, and protection of intellectual property rights. Regulations must encourage innovation, but also ensure public safety and social justice. Collaboration between government, academia, industry, and civil society is key to creating balanced policies, so that AI can be a tool for progress, not a threat. On the other hand, Indonesia must also be active in the global arena regarding ethical and legal standards for AI, adopting best practices from other countries while adapting to local values. Public education about the responsible use of AI, investment in domestic AI research, and the establishment of a special

supervisory institution will strengthen the nation's competitiveness. With a proactive approach, Indonesia can become one of the main players in the AI era, not just a spectator. Today's legal challenges must be answered with visionary policies so that future generations can reap the benefits of this technology fairly and sustainably.

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