Artificial Intelligence and International Law: Challenges and Opportunities

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Abstract

Artificial intelligence, as one of the transformative technologies of the contemporary era, has reshaped the traditional boundaries of international law and created unprecedented challenges and opportunities across various domains. This study, using a descriptive–analytical approach and relying on library and documentary sources, examines the complex interaction of artificial intelligence with the system of public international law. The main objective is to identify fundamental legal challenges such as the determination of responsibility in autonomous systems, violations of humanitarian principles in military weapons, threats to privacy, algorithmic discrimination in human rights, and intellectual property issues in works generated by artificial intelligence. Furthermore, the opportunities for enhancing legal processes, including big data analysis for predicting judicial outcomes, expediting proceedings, and facilitating equitable access to justice, are investigated. The findings indicate that existing legal mechanisms, such as UNESCO's recommendations and the European Union's Artificial Intelligence Act, lack global coherence, and there is a pressing need for multi-level and distributed governance models to manage risks. From a foresight perspective, artificial intelligence may lead to a redefinition of concepts such as sovereignty and responsibility, yet the risk of exacerbating digital inequalities and technological hegemony by developed countries persists. The conclusion emphasizes the necessity of drafting flexible, ethics-oriented, and internationally cooperative legal frameworks in order to balance technological innovation with the safeguarding of the fundamental principles of human rights. This study, by filling the research gap in the integrated analysis of challenges and opportunities, provides a foundation for future policymaking.

Keywords: Artificial Intelligence, International Law, Legal Challenges, Legal Opportunities, AI Governance

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1. Introduction

Artificial intelligence (AI), as one of the most transformative technologies of the contemporary era, has reshaped the boundaries of knowledge and practice in diverse domains, including international law (Goodfellow et al., 2016; Turing, 1950). Originating in the early twentieth-century efforts to simulate human thinking processes, AI has now evolved into complex systems capable of performing tasks that were once exclusively within human capability. AI can be defined as a

branch of computer science that focuses on developing systems and machines able to perform intelligent tasks (Goodfellow et al., 2016). This definition encompasses a wide range of applications, from simple algorithms to advanced autonomous systems. The historical evolution of this technology may be traced through several key phases: the first phase in the 1950s and 1960s, emphasizing rule-based systems and logical inference; the second phase in the 1970s and 1980s, with the emergence of expert systems and knowledge bases; the third phase in the 1990s and 2000s, marked by the development of machine learning; and the fourth phase, characterized by the advent of deep learning and neural networks, which enabled advanced capabilities in pattern recognition, natural language processing, and computer vision (Floridi, 2020; Hu & Lu, 2019).

These successive transformations have made AI a key tool in sensitive areas such as international security, global trade, and human rights (Ahmadian & Heydari, 2024; Beigi & Iqbali, 2024). However, its intersection with international law has generated multidimensional and unprecedented challenges rooted in its dynamic, unpredictable, and transnational nature (Kohneh Khush Nejad, 2024; Lu, 2024). One fundamental challenge concerns the legal status of AI systems, which do not fit into the traditional categories of natural or legal persons, thereby complicating the attribution of responsibility (Boggarapu, 2024; Liu, 2024). For example, in military operations, if an AI system makes a decision that results in violations of international humanitarian law, the question of responsibility—whether it lies with the designer, the user, or the system itself—remains unresolved (Asaro, 2012; Hosseini, 2024). This challenge extends into non-military fields such as international trade, where automated AI decisions may generate significant economic damages (Igbinenikaro & Adewusi, 2024; Khan, 2024).

The fundamental principles of international humanitarian law, including distinction, proportionality, and military necessity, are also seriously challenged by the use of AI in military operations (Faghani & Ghoreshi Mohammadi, 2025; Hosseini, 2024). The principle of distinction, requiring the separation of civilians and combatants, may be compromised due to algorithmic errors or technical limitations in accurately identifying targets. Similarly, proportionality, which requires balancing civilian harm against military advantage, may be undermined by AI systems' miscalculations. In the realm of intellectual property, generative AI capable of creating artistic works or innovative inventions has raised fundamental questions about authorship and ownership (Fithri & Priyono, 2024; Ghazi-Nouri, 2024). The famous *DABUS* case, where AI was registered as an inventor, exposed divergent and sometimes contradictory legal approaches: rejection in the United States and Europe, but acceptance in South Africa—underscoring the urgent need to reform patent law traditionally limited to human inventors (C. European, 2021b; Wipo, 2020).

In the sphere of international trade, AI offers opportunities for optimizing supply chains and reducing costs, while simultaneously raising challenges such as discriminatory tariff classifications and violations of the principle of non-discrimination (Khan, 2024; Trade & Technology, 2021). Generative AI systems producing commercial content further complicate ownership, potentially sparking trade disputes between states, particularly given jurisdictional differences in AI training practices (Igbinenikaro & Adewusi, 2024; Peng et al., 2021). In the field of human rights, AI's unprecedented ability to collect and process personal data increasingly threatens individual privacy, especially in the context of international communications (Kateeb & Khalaf, 2024; Unohchr, 2021). Moreover, algorithmic biases may reinforce systemic discrimination against particular groups—a phenomenon clearly visible in hiring, loan distribution, and the provision of public services (Cath et al., 2018; Kleinberg et al., 2018).

Despite these serious challenges, AI simultaneously presents unique opportunities for monitoring violations of international law, detecting human rights abuses, and facilitating the resolution of commercial disputes (Chain, 2023; Wishart, 2023). This dual capacity renders the systematic study of the interaction between AI and international law both urgent and necessary. The objective of this paper is to provide a comprehensive analysis of these challenges and opportunities within the framework of public international law. To achieve this aim, several theoretical frameworks are employed. The "Society 5.0" theory proposed by Japan emphasizes the integration of cyber and physical spaces to balance economic progress and social problem-solving, recognizing AI's central role, provided that it operates within international legal boundaries (Deguchi et al., 2020). The theory of multi-level governance illustrates how technology transforms traditional boundaries of sovereignty, requiring cooperation among local, national, and international actors for effective governance (Bozan, 1999; Marks et al., 1993). The theory of

distributed responsibility addresses how responsibility for complex AI systems must be shared among diverse stakeholders—from designers and programmers to users and producers—especially in sensitive areas such as autonomous weapons (Ahmadian & Heydari, 2024; Boggarapu, 2024). Finally, Joseph Nye's theory of "soft balancing," which defines power not only in terms of hard resources (military, economic) but also in soft resources (culture, ideology, institutions), helps explain AI's influence on the global balance of power and national capabilities (Nayy, 2013; West, 2019).

Nevertheless, the literature review shows that although multiple studies have examined various aspects of this interaction, most have focused on specific areas such as humanitarian law, human rights, intellectual property, or cybersecurity, while neglecting to provide an integrated analysis covering all dimensions of challenges and opportunities within public international law (Çami & Skënderi, 2023; Mollavi, 2023). This paper seeks to fill that research gap through a descriptive–analytical method and reliance on library and documentary sources, offering a more comprehensive picture of this complex relationship and paving the way for developing flexible, innovative, and equitable legal frameworks in the AI era.

2. Theoretical Framework

Artificial intelligence (AI), as one of the transformative technologies of the present century, has disrupted traditional boundaries of knowledge and practice in diverse domains, including international law (Goodfellow et al., 2016; Masha'i & Ghasem, 2025). Rooted in early twentieth-century efforts to simulate human thought processes, AI has now evolved into complex systems capable of performing tasks requiring human intelligence, with limited or no human intervention (Hu & Lu, 2019). AI is defined as a branch of computer science focused on developing machines and systems that execute intelligent tasks, covering a wide range of applications from simple algorithms to advanced autonomous systems (Goodfellow et al., 2016). The historical evolution of AI can be traced through key phases: the first phase in the 1950s and 1960s, emphasizing rule-based systems and logical inference, associated with Alan Turing's work and the introduction of the Turing Test as a benchmark for machine intelligence (Turing, 1950). The second phase in the 1970s and 1980s centered on expert systems and knowledge bases simulating human decision-making. The third phase in the 1990s and 2000s marked the rise of machine learning, enabling systems to learn from data without explicit programming. The fourth phase, completed with deep learning and neural networks, created advanced capabilities in pattern recognition, natural language processing, and computer vision (Goodfellow et al., 2016). This continuous evolution has made AI a critical tool in sensitive areas such as international security, global trade, and human rights (Ahmadian & Heydari, 2024; Beigi & Iqbali, 2024).

Within the framework of international law, AI introduces multidimensional challenges stemming from its dynamic and unpredictable nature (Kohneh Khush Nejad, 2024; Lu, 2024). One fundamental challenge is the legal status of AI systems, which do not fit traditional categories of natural or legal persons, thereby complicating issues of liability (Boggarapu, 2024; Liu, 2024). For example, in military operations, if an AI system makes a decision leading to violations of humanitarian law, it remains unclear whether responsibility lies with the designer, the user, or the system itself (Asaro, 2012; Hosseini, 2024). This dilemma also arises in non-military domains such as international trade, where AI-driven decisions may result in economic damages (Igbinenikaro & Adewusi, 2024; Khan, 2024).

The foundational principles of international humanitarian law—distinction, proportionality, and military necessity—are seriously challenged by AI applications in military contexts (Asaro, 2012; Faghani & Ghoreshi Mohammadi, 2025). The principle of distinction, requiring separation of civilians from combatants, may be violated due to algorithmic errors. Likewise, proportionality in assessing civilian harm faces difficulties when AI systems miscalculate (Asaro, 2012; Hosseini, 2024). In intellectual property law, generative AI that produces artistic works or inventions raises fundamental questions of authorship and ownership (Fithri & Priyono, 2024; Ghazi-Nouri, 2024). The well-known *DABUS* case, in which AI was registered as an inventor, revealed diverging approaches: rejection in the United States and Europe but acceptance in South Africa, highlighting the need to revise patent law traditionally limited to human inventors (C. European, 2021b; Wipo, 2020).

In international trade, AI offers opportunities to optimize supply chains and reduce costs, while also posing challenges such as discriminatory tariff classifications and violations of the non-discrimination principle (Khan, 2024; Trade & Technology,

2021). Generative AI producing commercial content further complicates ownership and may trigger trade disputes between states, especially due to jurisdictional differences in AI training (Igbinenikaro & Adewusi, 2024; Peng et al., 2021). In the realm of human rights, AI's ability to collect and process vast amounts of personal data increasingly threatens privacy in international communications (Beigi & Iqbali, 2024; Kateeb & Khalaf, 2024). Algorithmic biases also foster discrimination against vulnerable groups, evident in hiring, lending, and public services (Cath et al., 2018; Kleinberg et al., 2018). Despite these challenges, AI provides opportunities for monitoring international law violations, detecting human rights abuses, and facilitating trade dispute resolution (Chain, 2023; Wishart, 2023).

Several theoretical perspectives provide insights into the interaction between AI and international law. The Society 5.0 framework, proposed in Japan, emphasizes integrating cyber and physical spaces to balance economic progress with social problem-solving, recognizing AI's pivotal role provided it functions within international legal boundaries (Deguchi et al., 2020). This human-centered vision highlights AI's potential while stressing legal and ethical safeguards. The theory of multi-level governance, developed by Gary Marks, underscores the roles of local, national, and international actors in governance (Bozan, 1999; Marks et al., 1993). In the AI context, this theory reveals how technology alters sovereignty and necessitates multi-level cooperation among governments, international organizations, and the private sector to establish coherent frameworks (C. European, 2021a; Government, 2021).

The theory of distributed responsibility further addresses liability in complex AI systems, advocating the sharing of accountability among designers, programmers, users, and producers (Boggarapu, 2024; Floridi et al., 2018). This approach is especially pertinent in contexts such as autonomous weapons, where independent AI decision-making requires multi-stakeholder responsibility. To analyze AI's impact on national power and international relations, Joseph Nye's "soft balancing" theory is valuable, defining power not only in terms of hard resources (military, economic) but also soft resources (culture, ideology, institutions) (Nayy, 2013; West, 2019). AI acts as an instrument of soft power, enabling states that advance in this field to shift global balances and create new alliances. For instance, Saudi Arabia's national AI strategy for 2030 seeks to become a top 15 global AI leader, Turkey's 2021–2025 strategy aims for a 5% GDP contribution from AI, while Iran's 2024 national roadmap envisions leadership by 2033 but faces sanctions-related challenges (Ahmadian & Heydari, 2024; Khan, 2024). These comparisons illustrate how AI reshapes economic, military, political, and cultural dimensions of national power.

From the perspective of Islamic jurisprudence, AI generates challenges in liability and adjudication, where traditional jurisprudential rules provide general principles but require renewed interpretation for precise answers (Mohammaddoost et al., 2024; Mollavi, 2023). While dynamic principles such as *la darar* (no harm) may justify AI applications, ethical concerns—such as preserving human dignity—remain central. In Islamic human rights, AI must align with the principles of the Cairo Declaration, protecting fundamental rights such as dignity and health, though privacy violations remain problematic (Kateeb & Khalaf, 2024; Mollavi, 2023). Unlike conventional human rights frameworks, which often adopt flexible approaches, Islamic law treats ethical principles as firm standards.

The theory of technological determinism also applies, viewing technology as a driving force of social change. Yet in the context of international law, it requires an ethical orientation to balance opportunities—such as humanitarian crisis forecasting—with risks like algorithmic discrimination (Hallström, 2022). AI in foreign relations, exemplified by China's geopolitical forecasting platforms and U.S. analytical software, facilitates decision-making but simultaneously demands legal frameworks to prevent misuse (Gilbert & Gilbert, 2024; Peng et al., 2021).

Ultimately, this research integrates the perspectives of Society 5.0, multi-level governance, distributed responsibility, and soft balancing to explain the challenges and opportunities of AI in international law. This multidimensional approach underscores the need for flexible legal frameworks that support innovation while safeguarding fundamental principles (Helbing & Ienca, 2024; Masha'i & Ghasem, 2025).

3. Literature Review

Artificial intelligence (AI), as a transformative technology, has profoundly influenced the rules, institutions, and regimes of international law. It has simultaneously generated unprecedented legal challenges and created opportunities for enhancing the efficiency of the international system (Helbing & Ienca, 2024; Wishart, 2023). A review of existing literature shows that although multiple studies have examined aspects of this interaction, a comprehensive and integrated analysis of all dimensions of AI's challenges and opportunities in public international law remains absent. Most previous research has focused on specific areas such as humanitarian law, human rights, intellectual property, or cybersecurity, while neglecting the broader picture and systematic interconnections among these domains (Çami & Skënderi, 2023; Mollavi, 2023).

(Faghani & Ghoreshi Mohammadi, 2025) in a study titled *"The Use of Artificial Intelligence in Military Weapons: From the Perspective of Humanitarian Law Principles and Islamic Jurisprudence"* examined the challenges of employing autonomous weapons systems from the perspective of international humanitarian law and Islamic jurisprudence. This study emphasized the violation of fundamental principles such as distinction, prohibition of unnecessary suffering, and proportionality by AI-based weapons. Although it provides an in-depth military analysis, it does not address broader challenges of AI in other domains of international law, such as state responsibility or data governance.

(Wipo, 2020), in its document *"Revised Issues Paper on Intellectual Property Policy and Artificial Intelligence"*, investigated challenges related to ownership of AI-generated works and inventions. It highlighted the urgent need for new legal frameworks to protect intellectual property rights in the AI era. However, despite its comprehensive assessment of intellectual property issues, the report did not explore other dimensions of AI in public international law, such as state responsibility or security challenges.

(Asaro, 2012), in the article *"On Banning Autonomous Weapon Systems: Human Rights, Automation, and the Dehumanization of Lethal Decision-Making"*, argued that decisions on the use of lethal force should not be delegated to machines. This study provided a valuable ethical and human rights analysis of autonomous weapon systems but paid little attention to the positive opportunities of AI in improving the efficiency of international legal systems or dispute resolution, remaining largely theoretical.

(Kateeb & Khalaf, 2024) in the article *"Artificial Intelligence and Violation of International Human Rights Law: A Dialectical Relationship"* examined the dual impact of AI on international human rights. The study discussed both positive aspects, such as improved access to healthcare and education, and negative aspects, such as privacy violations. While comprehensive, the article did not address specific challenges of AI within public international law, such as state responsibility or sovereignty issues.

(Peng et al., 2021), in the book *"Artificial Intelligence and International Economic Law: Disruption, Regulation, and Reconfiguration"*, analyzed the impact of AI on international trade law, intellectual property, and investment. It offered an in-depth assessment of the need to revise international economic law. However, its focus was on economic dimensions, leaving unaddressed the challenges of AI in other branches of international law, such as humanitarian or environmental law.

(Lu, 2024), in the article *"Artificial Intelligence and International Law in the Context of Information Globalization: The Problem of Technological Hegemony as an Example"*, examined the technological hegemony of developed states. The study argued that these states seek to impose their technological standards on international law. Although valuable insights were offered from political and economic perspectives, the article did not address other challenges and opportunities of AI within international law.

(Chandra, 2023), in the article *"Advocates of the Future: Challenges and Opportunities of Robot Lawyers in Indonesia"*, explored the challenges of using AI in the legal profession, including the legal status of robot lawyers and accountability. While the study offered depth within a national and professional context, it did not extend its analysis to broader challenges of AI in the international legal system.

(Fithri & Priyono, 2024), in the article *"Issues and Possibilities in Regulating Artificial Intelligence Related to Copyright in Indonesia"*, analyzed the legal challenges of protecting AI-generated works. The study emphasized the need for copyright reform in the AI era. However, it focused on intellectual property within one national context, without addressing international dimensions or challenges beyond copyright.

(Gilbert & Gilbert, 2024), in the article *"Navigating the Dual Nature of Deepfakes: Ethical, Legal, and Technological Perspectives on Generative Artificial Intelligence (AI) Technology"*, examined the ethical and legal challenges of deepfakes. It considered both risks (e.g., misinformation) and opportunities (e.g., entertainment). Yet, its scope was limited to one particular AI application (deepfakes) and did not provide a comprehensive analysis of all AI-related challenges and opportunities in international law.

Overall, the review of prior studies reveals that existing literature has predominantly concentrated on specific branches or applications of international law. A clear research gap persists in offering an integrated analysis that encompasses all dimensions of challenges—such as state responsibility, sovereignty issues, security, and ethical dilemmas—and opportunities—such as improving the efficiency of legal systems, enhancing access to justice, and promoting peaceful dispute resolution. This study seeks to fill that gap and contribute distinctively to the body of scholarship on AI and international law (Ahmadian & Heydari, 2024; Masha'i & Ghasem, 2025).

4. Legal Challenges Arising from the Use of Artificial Intelligence in International Law

Artificial intelligence (AI), as one of the most prominent achievements of modern technology, has generated numerous challenges in the field of international law that demand in-depth analytical scrutiny. The deployment of AI across domains such as judicial decision-making, international trade, human rights, and intellectual property disrupts traditional legal structures and highlights the need to adapt existing rules to emerging realities. These challenges arise not only from technical aspects but also implicate ethics, accountability, and sovereignty. The following subsections examine key legal challenges stemming from AI's application in international law.

One of the principal challenges concerns human rights, which AI directly affects. Given AI's capacity to process massive datasets and render automated decisions, fundamental rights—such as the right to privacy—may be infringed. For example, AI-based surveillance systems used in cross-border communications often collect personal data without explicit consent, contradicting the principles of the European Convention on Human Rights and the International Covenant on Civil and Political Rights (Beigi & Iqbali, 2024; Gdpr, 2018; Unohchr, 2021). In transnational communications—where data traverse national boundaries—the core question is how to attribute state responsibility for privacy violations. AI can also embed algorithmic discrimination that targets minority groups based on historical data, conflicting with the international law principle of non-discrimination (Cath et al., 2018; Kleinberg et al., 2018). Empirical work indicates that facial recognition systems often perform less accurately on people of color, risking global human rights infringements (Kleinberg et al., 2018). Moreover, in the sphere of economic and social rights, AI may exacerbate inequalities because asymmetric access to advanced technologies places developing states at a disadvantage, undermining the Sustainable Development Goals (Imf, 2021; Oecd, 2019).

A further challenge concerns legal responsibility for automated decision-making. In international law, the principle of state responsibility is articulated through instruments such as the Geneva Conventions and international human rights norms; however, AI complicates attribution when opaque algorithms drive decisions. In the context of autonomous weapons systems used in international armed conflicts, identifying who is responsible for civilian casualties—the algorithm developer, the deploying state, or the system itself—is problematic, and this tension sits uneasily with international humanitarian law's requirement to distinguish civilians from combatants (Asaro, 2012; Faghani & Ghoreshi Mohammadi, 2025; Hosseini, 2024). In courts, the use of AI as a judge or judicial assistant raises concerns about a lack of transparent legal reasoning. Because AI cannot perform complex moral reasoning like humans, it may infringe the right to a fair trial as guaranteed by Article 14 of the ICCPR (C. European, 2021a; Rahbari & Shabaanpour, 2022).

In international intellectual property (IP), AI has posed profound challenges to longstanding regimes such as the Berne and Paris Conventions. A central question is the ownership of AI-generated inventions. Patent systems traditionally condition inventorship on a human inventor, yet AI can produce inventions without direct human input. The *DABUS* saga—where AI was presented as an inventor—has exposed this tension; while some jurisdictions rejected such filings, the episode underscored the vulnerability of current IP frameworks to emerging technologies (Ghazi-Nouri, 2024; Wipo, 2020). Data rights further complicate AI, because training modern models requires vast datasets that may be used without authorization from rights holders, colliding with international IP principles (Oecd, 2019; Wipo, 2020). In international trade, AI may facilitate

misappropriation of trade secrets, as machine-learning methods can infer confidential information from public data—raising potential conflicts with the TRIPS Agreement (Igbinenikaro & Adewusi, 2024).

Legal challenges likewise surface in international trade. Multilateral trade agreements, such as the GATT and the WTO framework, emphasize transparency and non-discrimination; yet opaque AI algorithms can unsettle these pillars. AI-driven systems used in global supply chains may automate commercial decisions which, if based on biased data, could result in discriminatory outcomes contrary to Article I of the GATT (Igbinenikaro & Adewusi, 2024; Trade & Technology, 2021). Product-liability issues for AI-enabled goods (e.g., autonomous vehicles traded internationally) complicate choice-of-law analysis. Although the EU's Rome II Regulation governs non-contractual obligations, black-box characteristics of AI can hinder causal inference and frustrate the Regulation's application (Çami & Skënderi, 2023)—a difficulty that underscores the need for cross-system coordination.

In public international law, AI intensifies challenges in cyber sovereignty. When states deploy AI in cyber operations, attribution becomes harder, enabling plausible deniability and undermining responsibility under international law. While the Budapest Convention addresses cybercrime, AI's rapid evolution outpaces extant norms. In international economic law, AI can disrupt global markets as dominant technology firms leverage data monopolies to curtail competition, contrary to the spirit of WTO principles (U. European, 2021; Wishart, 2023).

Ethical concerns are integral to the legal analysis. AI may render decisions without accounting for cultural values, thereby colliding with norms of international cultural law and UNESCO instruments. For instance, AI-based translation can distort culturally embedded content, affecting the right to access cultural information (Beigi & Iqbali, 2024; Unesco, 2021).

In global health, AI applications for disease detection (e.g., COVID-19) raise accuracy and reliability concerns. During the pandemic in Georgia, AI supported risk communication, but ensuring information accuracy proved challenging and could implicate the right to health (Skhvitaridze et al., 2023; Who, 2021).

Private international law faces its own set of issues, notably in jurisdiction and applicable law. Cross-border AI disputes complicate forum selection because AI disregards territorial boundaries. The EU's Brussels I regime seeks to structure jurisdiction, yet black-box opacity complicates proof of causation in tort under Rome II (Çami & Skënderi, 2023). Originality in AI-generated works also tests the Berne Convention's assumption of human authorship, raising persistent questions for international copyright protection (Fithri & Priyono, 2024; Ghazi-Nouri, 2024). At the national level with international relevance, use of AI as a judge challenges impartiality where models are trained on skewed data, conflicting with fair-trial guarantees under international law; in Iran, for example, doctrinal requirements of a human judge further preclude AI substitution (Rahbari & Shabaanpour, 2022). Free-expression concerns arise as AI-driven platforms filter content, risking censorship and implicating Article 19 of the ICCPR, particularly across borders where algorithmic moderation can distort information flows (Beigi & Iqbali, 2024; Unohchr, 2021). In e-commerce, smart contracts powered by AI raise liability questions for algorithmic errors with potential friction against the CISG (Igbinenikaro & Adewusi, 2024).

Industrial property presents parallel difficulties. AI can generate trademarks resembling registered marks without intent, complicating infringement proof. While the Paris system protects industrial property, AI complicates similarity assessments, often relying on incomplete or biased datasets and spurring transnational disputes. Likewise, trade secrets protected under TRIPS face novel risks where AI extracts confidential inferences from public data, challenging secrecy maintenance (Ghazi-Nouri, 2024). Globally, WIPO is studying these problems, but progress remains gradual, and revisions to legacy conventions may be necessary (Wipo, 2020).

Further private international law hurdles include forum determination and choice of law for AI-related harms. As AI renders disputes intrinsically transnational, Brussels I and Rome II face stress tests; the black-box nature of AI can frustrate causation, suggesting the need for new treaty-level instruments on AI responsibility (Çami & Skënderi, 2023; Wishart, 2023).

In human rights, AI also impacts the rights to education and access to information. While AI can personalize online education, models trained predominantly on Western datasets risk marginalizing the cultural content of developing countries, conflicting with UNESCO's commitments to cultural diversity (Beigi & Iqbali, 2024; Unesco, 2021). AI-based translation in cross-border communication can misrepresent meaning and undermine freedom of expression. During health crises such as the

COVID-19 pandemic, AI tools aided risk communication, yet ensuring accuracy remained a challenge for the right to health globally (Skhvitaridze et al., 2023; Who, 2021).

Domestic judicial challenges with international implications include the use of AI as an assistant or judge. Although AI can analyze large case corpora, its inability to engage in complex moral reasoning threatens fair-trial guarantees; in Iran's Sharia-influenced system, a human judge is a doctrinal requirement, rendering AI an unacceptable substitute and raising tensions with ICCPR standards (Rahbari & Shabaanpour, 2022). At the international level, bodies like the ICC may employ AI for evidence analysis, but algorithmic bias threatens impartiality (Cath et al., 2018; C. European, 2021a).

In international commerce, AI complicates smart contracts that operate atop blockchain. Algorithmic errors may conflict with the CISG, and discerning party intent becomes pivotal because AI can simulate—yet does not possess—legal will. In international competition law, AI can facilitate tacit or "virtual cartels" that coordinate pricing, contravening Article 101 TFEU analogues and comparable competition norms (Igbinenikaro & Adewusi, 2024; Oecd, 2019).

Environmental challenges also arise. Although AI supports climate-change monitoring, the substantial energy consumption of data centers contributes to carbon emissions, pressing against Paris Agreement goals; forecasting algorithms can also mislead national commitments if their outputs are unreliable (Miller, 2020; Oecd, 2019). In migration and asylum, AI-based triage tools risk discriminatory outcomes, potentially conflicting with the 1951 Refugee Convention (Beigi & Iqbali, 2024; Unohchr, 2021). In the law of the sea, autonomous vessels employing AI raise questions of liability for maritime incidents with implications under UNCLOS—an area signaling the need for updated protocols (Wishart, 2023).

Cyber challenges are equally salient. AI is deployed in cyberattacks, and the difficulty of attribution strains state-responsibility doctrines in international law. The Budapest framework offers partial coverage, but AI's pace outstrips regulatory adaptation, pointing to the necessity of multilateral standard-setting on transparency, accountability, and ethics (Helbing & Ienca, 2024; Wishart, 2023). Ultimately, addressing AI's challenges in international law requires robust, cooperative, and flexible governance arrangements capable of balancing innovation with rights protection, lest AI deepen global inequalities and erode the international legal order (C. European, 2021b; Masha'i & Ghasem, 2025).

5. Opportunities to Enhance Legal Processes through Artificial Intelligence

Artificial intelligence (AI), as one of the most transformative technologies of the present era, is reshaping the traditional frameworks of international legal systems. By leveraging capabilities in big-data analytics, pattern discovery, and process automation, AI enables unprecedented improvements in efficiency, accuracy, and fairness within international legal procedures. Although the legal and ethical challenges of deploying AI are undeniable, this section focuses on the positive dimensions and explores novel opportunities AI offers to international legal systems. Using a descriptive–analytical approach and drawing on authoritative sources, this study examines AI's potential to optimize legal-document analysis, expedite adjudication, increase the accuracy of judicial outcome prediction, and broaden equitable access to justice (Floridi, 2020; Wishart, 2023).

AI's capacity to process vast volumes of legal documents and data is among its most salient advantages. Systems based on machine learning and natural language processing can, at speeds incomparable to human capability, analyze thousands of pages of judicial opinions, international contracts, and arbitral awards, extracting reasoning patterns and conceptual structures. This capability has triggered a remarkable transformation in research and legal inference, especially in fields like international trade law that confront massive documentation. For example, advanced algorithms performing comparative analyses across the jurisprudence of different countries can map overlaps and divergences and thereby foster greater convergence among legal systems, while also surfacing hidden patterns that support more precise standards and forecasting of outcomes (Durur-Subasi & Özçelik, 2023).

Accelerating judicial processes and improving the productivity of adjudicatory institutions is another significant opportunity created by AI. By automating repetitive, time-consuming tasks—such as file triage, extraction of key facts, and even drafting opinion templates—AI enables judges and legal professionals to focus on more complex legal questions. Evidence suggests that intelligent systems can accurately classify cases based on criteria such as priority, complexity, or likelihood of success, and can even suggest potential strategies for defense or claim, which is particularly helpful in international fora with heavy

caseloads. In parallel, AI-based tools, including conversational agents, can act as virtual assistants to answer preliminary user queries and reduce the workload of legal service offices (Fonseca, 2024; Mahmoudi & Bahrkazzemi, 2024).

AI also exhibits considerable capacity to increase the accuracy and predictive power of legal outcomes. By analyzing historical case data, deep-learning algorithms can identify patterns that enable predictions of litigation results or regulatory violations with accuracy beyond conventional techniques. In international commercial contracting, for instance, intelligent systems that review large corpora of agreements and related awards can flag ambiguous clauses or weaknesses that increase the risk of future disputes, allowing parties to remedy defects pre-signature and avoid costly conflicts (Kavan & Azizi, 2024). In the sphere of international criminal law, AI-assisted analysis of data concerning organized crimes can reveal financial networks, criminal patterns, and even forecast future hotspots—insights that not only aid prevention but also provide probative value for international tribunals (Reich & Meder, 2023).

Facilitating equitable access to legal services and justice is among AI's most far-reaching social impacts in international law. Technologies such as online legal advisory platforms, real-time legal translation tools, and virtual training environments can reduce linguistic, geographic, and economic barriers—benefitting, in particular, developing countries facing shortages of legal experts and judicial infrastructure. Low-cost AI tools offering preliminary legal analysis can extend access to justice broadly. Moreover, data-driven instruments can identify underserved regions through demographic and economic analytics, thereby informing policymakers' targeted resource allocation and supporting fairer, evidence-based legal policies that reduce structural inequalities in access to justice (Fonseca, 2024).

In sum, by delivering powerful data-analysis tools, automating workflows, boosting predictive accuracy, and lowering barriers to judicial services, AI creates exceptional opportunities to enhance international legal systems. Realizing this potential, however, requires suitable legal-ethical frameworks, investment in technological infrastructure, and specialized training for legal professionals. Cross-border cooperation to develop shared standards and protocols for AI use in legal processes will be key to achieving this positive transformation in international law (C. European, 2021a; Oecd, 2019).

6. Assessing International Legal Mechanisms and Policy Frameworks for AI Governance

International legal mechanisms governing AI remain at an early stage of development and lack a coherent, global framework. The European Union has taken the lead with its draft Artificial Intelligence Act, which classifies systems by risk level and proposes comprehensive obligations calibrated to those risks (C. European, 2021b). By contrast, the United States has tended toward a more flexible, sector-based approach grounded in ethical guidance and soft standards, while China has adopted a centralized framework emphasizing state control and national security through instruments such as the Data Security Law (Ding et al., 2021; West, 2019).

Globally, UNESCO's 2021 Recommendation on the Ethics of Artificial Intelligence marked a significant step toward establishing an international ethical framework; though nonbinding, it articulates key principles such as transparency, fairness, and sustainability (Unesco, 2021). The OECD's AI Principles likewise provide a policy framework that foregrounds inclusive human-centred values and accountability and has been endorsed by numerous jurisdictions (Oecd, 2019).

A central challenge in building international mechanisms is the divergence among major powers' governance philosophies: the EU prioritizes rights protection, the U.S. emphasizes innovation, and China stresses national security—differences that complicate global coordination and create regulatory "islands." The rapid pace of technological change further strains slow legislative processes, risking regulatory obsolescence (Floridi, 2020; Kohneh Khush Nejad, 2024). Responsibility and accountability also remain core legal issues: attributing liability for harms caused by AI systems is difficult given the technology's complexity and the multiplicity of stakeholders, necessitating foundational re-design of liability frameworks (Nemitz, 2019). In public international law, AI raises new questions—ranging from autonomous military force to automated border surveillance—for which existing conventions provide incomplete answers (Asaro, 2012).

At the technical-normative interface, bodies such as the International Organization for Standardization are developing standards for risk management and AI system safety—building blocks that can underpin future legal frameworks. Multistakeholder initiatives, including the Partnership on AI, seek to facilitate international cooperation and best-practice

exchange; the emergence of international technical standards is a key opportunity for regulatory alignment across jurisdictions (Iso/Iec, 2018; Partnership on, 2020). Yet assessment of current mechanisms reveals notable gaps: many approaches remain overly focused on technical controls while insufficiently engaging social, cultural, and ethical dimensions, and power asymmetries in global bargaining tend to amplify developed countries' priorities over those of developing states (Floridi, 2020; Lu, 2024).

To address these structural challenges, scholars and practitioners have advanced several proposals. Creating a specialized international body under the auspices of the United Nations could play a central role in standard harmonization and effective oversight of AI regulation. In parallel, negotiating a comprehensive international instrument that sets baseline global standards in core areas—such as civil liability, algorithmic transparency, and privacy—could mitigate legal fragmentation. Ensuring a genuinely multistakeholder approach that includes governments, technology firms, academia, and civil society is essential for legitimacy and broad uptake (Cath et al., 2018; U. European, 2021).

In conclusion, assessment of existing regimes indicates that—despite the efforts of entities such as UNESCO and the European Union—achieving a coherent, fair, and effective global governance framework for AI will require stronger political will and deeper collaboration among all actors. Success depends on striking a careful balance between fostering technological innovation and safeguarding human dignity, fundamental human rights, and the public interest (C. European, 2021b; Unesco, 2021).

7. International Governance Models and Lessons from Existing AI Mechanisms

International governance of artificial intelligence refers to the set of rules, norms, and oversight mechanisms designed to guide the development and application of AI technologies at the global level. The transboundary nature of this technology and its broad impacts on economic, social, and security dimensions have made the establishment of international governance frameworks increasingly necessary. At present, multiple models have been proposed to organize this domain, each with its own advantages and shortcomings.

One prominent model relies on existing international institutions. Organizations such as UNESCO, the Organization for Economic Co-operation and Development (OECD), and the European Union have been shaping policy and regulatory frameworks through instruments like the "Recommendation on the Ethics of Artificial Intelligence," the "OECD AI Principles," and the "Artificial Intelligence Act." These documents emphasize principles such as transparency, accountability, respect for human rights, and a human-centered approach (C. European, 2021b; Oecd, 2019; Unesco, 2021).

Another model places multistakeholder governance at its core. In this model, governments, the private sector, civil society, and academic institutions collaborate—through initiatives such as the Partnership on AI—to develop standards and best practices. In addition, international standard-setting bodies such as ISO and IEC contribute by issuing technical standards that enhance the reliability and security of AI systems (Iso/Iec, 2018; Partnership on, 2020).

Nevertheless, international AI governance faces numerous challenges. The concentration of technological and data power in a small number of major private actors and developed countries risks creating inequities in the distribution of benefits and responsibilities (Helbing & Ienca, 2024). Differences in legal and value-based approaches among states—for example, the European Union's emphasis on privacy versus some states' prioritization of economic development—also complicate coordination toward global standards.

A further key challenge concerns data governance and accountability. Divergent national data laws—such as the EU's General Data Protection Regulation (GDPR)—affect cross-border cooperation. In addition, assigning responsibility for actions taken by autonomous AI systems, especially where decisions are inexplicable, has become a complex problem (Gdpr, 2018; Liu, 2024).

Several solutions have been proposed to meet these challenges. Creating specialized international bodies with supervisory powers could better address the complexities of emerging technologies (Helbing & Ienca, 2024). Anchoring AI system design and deployment in the international human rights framework can help safeguard human dignity (Unohchr, 2021). Bilateral

and regional initiatives, such as the U.S.–EU Trade and Technology Council, may also facilitate higher-level coordination (Trade & Technology, 2021).

In conclusion, designing an effective international governance framework for AI requires comprehensive, multi-level cooperation among stakeholders. Such a framework must both support innovation and economic development and protect fundamental human rights and democratic values. As Helbing and Ienca argue, governing these transformative technologies calls for a preventive, flexible, and holistic approach (Helbing & Ienca, 2024).

8. The Future and Prospects of AI and International Law

The accelerating development of AI is fundamentally reshaping the frameworks of international law. By providing novel tools for big-data analysis, automation of legal processes, and simulation of complex scenarios, AI has the potential to redefine traditional concepts such as state sovereignty, state responsibility, and the functions of international institutions. Future advances in areas such as data governance, ethical standards, and oversight mechanisms will play a pivotal role in shaping the global legal order (Ahmadian & Heydari, 2024). With the ability to process vast quantities of legal data on a global scale, AI paves the way for new transnational institutions. For example, AI-based platforms for monitoring treaty obligations could enable real-time detection of violations and automated analysis of consequences—transforming organizations such as the United Nations from reactive bodies into anticipatory ones (Masha'i & Ghasem, 2025).

In this outlook, advanced algorithms will be able to predict the likelihood of conflicts by analyzing historical patterns and activate intervention mechanisms before crises escalate. However, the absence of integrated legal frameworks for managing sovereign data risks consolidating power in technologically leading states. In a scenario sometimes described as "hyper-intelligent colonialism," such states, by controlling data infrastructure and algorithms, could dominate international institutions and shape global norms in line with their interests. Countering this risk requires multilateral institutions endowed with independent supervisory authority and operating on principles of transparency and fairness (Ahmadian & Heydari, 2024).

One of the most complex challenges ahead is assigning legal responsibility when autonomous AI systems cause human rights violations or international delicts. The current legal gap concerning the "legal personality" of AI can leave no clearly accountable party in incidents such as attacks by autonomous weapons systems. The future of international law will likely require the development of concepts such as "algorithmic responsibility." Mechanisms like an "AI Compensation Fund," financed by developers and states, could provide redress for harms caused by system errors, while international courts expand jurisdiction and craft standards to define "algorithmic offenses" (Hu & Lu, 2019; Xue, 2021).

AI can also serve as a catalyst for strengthening multilateral cooperation. Negotiating a "Global Convention on AI Ethics" under UN auspices could entrench shared principles—such as prohibiting algorithmic discrimination, protecting privacy, and ensuring decision-making transparency—and establish dispute-settlement mechanisms in sensitive areas like cybersecurity (Wishart, 2023). A key opportunity lies in improving access to international justice: AI systems that analyze cases automatically can reduce litigation costs and enable developing countries to pursue claims, provided shared technological infrastructure and knowledge transfer prevent a widening digital divide (Wen, 2019).

The development of AI brings significant ethical risks. A central concern is the potential for systematic global privacy violations. AI-driven surveillance—such as facial recognition—could enable prediction and control of citizen behavior, conflicting with human rights charters. Another risk is "algorithmic discrimination" in international decision-making; biased training data can produce discriminatory outcomes in domains such as asylum or development aid. Addressing these risks requires global standards for "algorithm testing" prior to deployment in international institutions, along with ethical guidance compelling states to disclose data sources and training methods (Miller, 2020; Overdahl, 2023; Unesco, 2021).

Successful engagement with these transformations requires close cooperation among academia, research centers, and diplomacy. Building interdisciplinary programs such as "Law and AI" can train a new generation of legal professionals fluent in both legal principles and the technical foundations of AI, while science diplomacy can help manage risks. Intergovernmental negotiations on autonomous weapons control can advance in forums such as the UN Conference on Disarmament; proposals such as additional protocols to existing arms-control treaties to cover "smart" weapons illustrate one pathway. Establishing a

"Global Center for AI Legal Innovation" could convene international experts to devise practical solutions to emerging challenges (Chain, 2023; Hu, 2020).

In the long term, international law is likely to evolve toward an order in which AI is recognized not merely as a tool but as an active participant. Concepts such as "algorithmic sovereignty" and "data-driven distributive justice" may supplant traditional frameworks. Yet developing countries may lag due to infrastructural constraints. To avoid deepening the digital divide, a UN-administered "AI Technology Facilitation Fund" for knowledge and technology transfer would be essential. Ultimately, the future of international law will hinge on the global community's ability to strike a balance between innovation and effective oversight (Metz, 2023).

9. Discussion and Conclusion

The findings of this study indicate that artificial intelligence (AI), as a transformative technology, has generated unprecedented challenges and opportunities within the international legal system. The analysis suggests that the transboundary and unpredictable nature of AI has subjected the traditional foundations of international law to a profound test. On the one hand, legal challenges emerge from the absence of comprehensive regulatory frameworks, accountability issues, and conflicts with fundamental humanitarian law principles; on the other hand, unique opportunities have arisen to enhance the efficiency of international judicial systems and to facilitate access to justice.

In the field of legal challenges, the findings reveal that AI has altered traditional boundaries of state sovereignty, turning the attribution of responsibility for the actions of autonomous systems into one of the most complex issues in contemporary international law. As Asaro notes, the use of autonomous weapon systems seriously challenges fundamental principles of humanitarian law, including distinction and proportionality (Asaro, 2012). These challenges become even more complicated when AI systems are deployed in cyberspace, making the attribution of acts to states difficult.

In the area of human rights, the findings indicate that AI is simultaneously a tool for monitoring violations and an agent for infringing upon fundamental rights such as privacy and non-discrimination. As Kateeb and Khalaf argue, AI has a dialectical relationship with international human rights law (Kateeb & Khalaf, 2024). On the one hand, the technology can identify patterns of human rights violations through big data analysis; on the other hand, it can itself become a tool for systematic violations of human rights.

In the domain of intellectual property (IP), the study finds that current IP regimes, including the Berne and Paris Conventions, are inadequate to address the challenges posed by AI-generated creations. The DABUS case illustrates how AI challenges the traditional concept of "inventor" (Wipo, 2020). These challenges underscore the need for fundamental revisions in IP law.

In contrast to these challenges, the findings demonstrate that AI offers unique opportunities to enhance the functioning of international law. As Durur-Subasi and Özçelik emphasize, AI's ability to process massive volumes of legal data can uncover hidden patterns and predict judicial outcomes (Durur-Subasi & Özçelik, 2023). Such capacities can enhance the efficiency of international courts and reduce litigation costs.

With regard to international governance, the findings highlight that current regulatory approaches to AI suffer from fragmentation and incoherence. As Floridi explains, the rapid pace of technological development challenges the slower processes of legislation (Floridi, 2020). This regulatory gap risks creating "regulatory islands" and increasing inequality in global AI governance.

A comparative analysis of governance models shows that the European Union's approach emphasizes citizen rights protection, the United States prioritizes innovation, and China prioritizes national security—revealing fundamental divergences in regulatory values and priorities. These differences make global coordination difficult and underscore the urgent need for multistakeholder frameworks.

From a theoretical perspective, the findings demonstrate that the concepts of Society 5.0, multi-level governance, distributed responsibility, and soft-balancing provide useful analytical frameworks for understanding the complex interactions between AI and international law. As Deguchi and colleagues point out, Society 5.0 offers a framework for integrating cyber and physical

spaces, balancing economic progress with the resolution of social issues (Deguchi et al., 2020). This framework can guide the management of legal and ethical challenges posed by AI.

Regarding future scenarios, the findings indicate that AI has the potential to become an active player in international law. As Metz notes, concepts such as "algorithmic sovereignty" and "data-driven distributive justice" may replace traditional frameworks (Metz, 2023). Such transformations require a redefinition of fundamental concepts of international law, including sovereignty, responsibility, and justice.

However, the findings also reveal the risks of "hyper-intelligent colonialism" and the widening digital divide between developed and developing countries. As Ahmadian and Heydari argue, technologically advanced states may dominate international institutions by controlling data infrastructures and algorithms (Ahmadian & Heydari, 2024). This risk highlights the need for multilateral institutions with independent supervisory authority.

In terms of theoretical implications, this study shows that international law must develop new paradigms capable of addressing the complexities introduced by AI. Traditional theories of international law, which are based on state sovereignty and intergovernmental relations, are insufficient to address the challenges of emerging technologies.

From a practical standpoint, the findings of this study can assist policymakers and international institutions in designing appropriate regulatory frameworks. The creation of specialized international bodies, the drafting of comprehensive treaties, and the development of technical standards can help close existing regulatory gaps.

The limitations of this research include its focus on key challenges and opportunities of AI in international law, without delving deeply into every aspect of this complex interaction. Moreover, the rapid pace of AI development may render some of the findings outdated in a short time.

For future research, it is recommended to examine the impact of AI on specific branches of international law, such as the law of the sea, environmental law, and space law. Comparative studies of AI governance models across different countries can also provide a deeper understanding of the challenges and opportunities ahead.

In conclusion, it can be argued that AI will shape the future of international law, just as international law will influence the trajectory of AI development. Achieving a balance between innovation and oversight, respect for human rights, and technological progress will be the key to success in this complex path. International cooperation, intercultural dialogue, and the participation of all stakeholders can help build a fair and sustainable future for all.

Ethical Considerations

All procedures performed in this study were under the ethical standards.

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Conflict of Interest

The authors report no conflict of interest.

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