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EXECUTIONAL GAPS IN INTERNATIONAL LAW IN THE AGE OF ADVANCING TECHNOLOGIES

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1. ABSTRACT

There are new gaps that pose problems in the international legal order because of the advancement and emergence of fields like Artificial Intelligence, Biotechnology, Cybernetic Technologies, alongside Ministerial and Parliamentary gaps, lack of appropriate treaties, and inter-state legislation. The gaps of developed treaties are not sufficient enough to offer a clear path for the management of complicated national issues which results in differences in application of these treaties across nations. The absence of universal agreement on criteria, ethical issues, and principles for conflict resolution aggravates the issue of compliance and responsibility. Moreover, the rapid pace of changes associated with new technologies and modernization of international law has developed the need for swift changes to be adapted to international law. The abovementioned gaps pose problems in executional gaps which require collaborative efforts between nations.

Keywords: *international law, modernization, technology,*

2. INTRODUCTION

There is a gap between rapidly advancing technologies... and sluggishly evolving international, AI, cyber warfare, space exploration, and biotechnology. Emerging Technologies reveal gaps in existing laws, treaties, conventions, and international governing bodies striving to address cross border concerns and sustain global order, while the implementation and enforcement is routinely hindered by the intricacies of regulation, jurisdictional vagueness, decentralized innovation, and technologies' anti-embedded nature. These cross border

concerns and the gaps they create face mounting barriers.

This research addresses how the creation of legal norms fails to juxtapose with their practical execution within international law. Through examining the existing frameworks, this study seeks to understand the unregulated, unmonitored, ungoverned transnational actions that constitute technological mischief, including cybercrime, digital surveillance, autonomous weaponry, and breaches of data privacy. Additionally, this analysis looks into international legal bodies' enforcement shortcomings, presenting key illustrative case studies, and proposing critical reforms needed to fill these gaps.

3. INTERNATIONAL BODIES RESPONSIBLE AND LEGAL FRAMEWORK

I) United Nations (UN)

The UN is a central body for development and coordination of international law. Within it, the UN General Assembly (UNGA) plays a key role specially through its sixth committee, which addresses legal matters and refers topics to the International Law Commission (ILC). the ILC, composed of Legal Experts elected by the UNGA, responsible for drafting and promoting the progressive development of international law. the UN Security Council (UNSC) adopt bindings resolutions under chapter VII all the UN charter and is responsible for enforcing international law related to peace and security.

II) International Court of Justice (ICJ)

The ICJ is the principal judicial organ of the UN. It settles legal disputes between states and provides advisory options on legal questions referred by UN organs and specialised agencies. its decisions are binding on the parties involved

III) International Criminal Court (ICC)

Several regional courts support international law within specific geographical areas. the European Court of human rights (ECHR) enforces the European convention on human rights. the Court of Justice of the European Union (CJEU) interprets and ensures the uniform application of EU law. the the inter American Court of Human Rights applies the American convention on human rights, while the African quote on human and

peoples rights uphold the African charter on human and people's rights

The ICC is an independent judicial institution established by the job statute of 1998. it prosecute individuals, not States, for serious International crimes including genocide, crimes against humanity, war crimes, at the crime of aggression.

IV) World Trade Organization (WTO)

the WTO oversees the international trade law framework. It administers trade agreements and resolves trade disputes between member states through its dispute settlement body, whose decisions are binding.

V) International Tribunal for the Law of the Sea (ITLOS)

ITLOS handles disputes related to Maritime law and applies the United Nations convention on the law of the sea (UNCLOS). it plays a critical role in interpreting Maritime rights and obligations.

VI) Regional Courts and Organizations

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4. EXECUTIVE GAPS AND PROBLEMS

i) Absence of technology specific legal framework

One of the most glaring executional gaps in international law is the absence of technology specific legal instruments that address the unique challenges posed by emerging Technology such as artificial intelligence biotechnology and cyber capabilities. Most International treaties and conventions were conceived in a different technological era and are inadequate for the nuanced threats of modern innovation. Currently no binding International Treaty that regulates the use of Lethal Autonomous Weapons Systems (LAWS) shows the ethical use of AI in military operations, this lack of regulation leaves a dangerous grey zone and non-state actors can exploit technological advancements with minimal oversight or accountability.

ii) Inadequate enforcement mechanisms

Even where legal norms exist International Law suffers from weak or nonexistent enforcement mechanisms specially in the realm of transnational technological threats. Enforcement remains largely dependent on national legal systems, which differ greatly in terms of capability, willingness, and political motivations. For example, all the Budapest convention on cyber crime provides a Framework for addressing cross borders cyber threats, its enforcement is undermined when cyber criminals operate from jurisdictions that refuse to cooperate or lack the infrastructure to investigate Complex digital crimes. This fosters a culture of impunity, especially for state sponsored or politically protected cyber operations.

iii) Inconsistency across borders

There is no single universal policy or convention in place regarding new technology regulations globally. Countries have different policies for new technologies, creating an imbalance legally. This imbalance generates gaps in the law which are easily exploitable by choosing permissive jurisdictions. A useful example would be the European Union's Regulations on General Data Protection and the use of Facial Recognition Technology (FRT). While the Union imposes stringent rules on facial recognition use within its jurisdictions, authoritarian regimes employing such technology for mass surveillance often escape scrutiny. Not only does this situation put human rights at risk, but it also makes it increasingly difficult to formulate a useful standard which could universally be applicable internationally.

iv) Limited scope and jurisdiction of existing treaties

Many existing International treaties applied only to States are required voluntary ratification, which limits the reach and effectiveness. For instance, the Rome statute that established the international Criminal Court ICC does not have jurisdiction over crimes committed in non member states unless referred to by the UN Security Council. This severely curtails its ability to prosecute crimes involving biotechnology or cyber warfare when powerful countries like the United States, Russia and China are not parties to the Treaty. As a result, there are significant gaps in accountability for actors operating beyond the legal reach of existing mechanisms.

v) Ambiguity in definitions

International Law relaxes precise definitions for terms relevant to emerging Technologies, which results in insignificant interpretative ambiguity terms such as cyber attack, autonomous weapons or dual use biotechnology are either undefined or weakly described in international instruments, allowing states and other actors to interpret them in self serving ways. This ambiguity creates loopholes that enable misuse of Technology while making it difficult for enforcement bodies to establish legal liability. A shared legal lexicon is essential for meaningful International cooperation, and its absence is a significant obstacle to effective governance.

vi) Lack of realtime responsiveness

The slope pairs of international law making is inherently incompatible with the rapid development of modern technologies. The process of drafting, negotiating, stratifying, and implementing International treaties often takes years if not decades while Technologies like AI and Biotechnology evolve in months and makes international legal responses obsolete or insufficient by the time they are enacted. For instance, while States deliberate on how to regulate AI in warfare, autonomous drones and surveillance systems are already been deployed on the battlefield, leaving no legal safeguard against potential abuse

vii) Weak institutional oversight

Another critical gap is the absence of strong International institutions with the authority to monitor and regulate the Global use of emerging Technologies. Unlike issues such as trade governed by WTO or nuclear proliferation (overseen by the IAEA), there is no Central body responsible for supervising the Global development and deployment of AI, cyber capabilities, and biotechnology. The vacuum in institutional oversight means that enforcement is often left to informal diplomacy, bilateral agreements, or industry self regulation, which are inconsistent and often ineffective in addressing systemic risks.

viii) Non- state actor accountability

Current frameworks of international law are predominantly state centric and often fail to account for the rising influence of non-state actors, specially in the Technology Sector, last technology companies, cyber criminal groups, and even autonomous AI

systems can wield significant transnational influence without being subject to meaningful international legal constraints. For instance, Tech corporations can develop and deploy tools that affect privacy, manipulate information, or even support military operations, with little fair or legal reprisal under international law. This lack of accountability for non-state entities represents a serious executional gap.

ix) Ethical and normative disagreements

The complication arises from lack of global consensus on the ethical use of new technology. Cultural, political and philosophical differences lead to widely varying norms and ethical standards between nations. While some States prioritise privacy and human dignity, others may emphasize national security or economic development, even at the cost of civil liberties. For instance, the ethical debate surrounding human gene editing technologies like CRISPR has led to a divide between countries that banned or heavily restrict its use and others that promote it. This disagreement makes it challenging to form coherent International norms.

x) Lack of multilateral cooperation

Geopolitical tensions and strategic rivalries under the formation of multilateral agreements necessary for effective regulation of emerging Technologies. major powers of a view international legal constraints as a threat to the strategic or economic interest, leading to a reluctance to enter into binding commitments. The persistent rivalry between the US and China in AI and 5G technologies, and cyber warfare demonstrates the cooperation undermined by strategic distrust. In an atmosphere of scant political collaboration and trust, endeavours seeking to fill the gaps within international legislation are neglected.

5. CASES PROVING FAILURE OF EXECUTIVE FRAMEWORK

i) NotPetya cyber attack (2017)

The NotPetya Malware, launched by Russian military hackers, cost billions in global damage, heating companies like Maersk and Merck. Its scale and suspected state backing, there was no formal International response or legal action. The incident exposed a significant gap in international cyber law, with neither attribution mechanisms nor enforcement tools are clearly defined or effective.

ii) Stuxnet attack on iran

A joint US Israel operation used the Stuxnet worm to sabotage Iran's nuclear program, marking the first known cyber weapon to cause physical damage. No international body addresses this clear act of digital aggression. The case highlighted how cyber warfare falls into a legal vacuum beyond the reach of existing arms control and conflict resolution treaties.

iii) CRISPR gene mutated babies

Chinese scientist Jiankui created the world's first gene-edited babies, violating Global ethical norms. While he was prosecuted under Chinese law, there was no International mechanism to regulate or penalize such Biotech experiments. This revealed the absence of a binding international legal framework a human genetic editing, despite its Global implications

iv) Covid 19 origin controversy

China's initial lack of transparency and data sharing regarding the covid-19 outbreak undermined Global Health efforts. All the World Health Organisation has rules under the international health regulations 2005, its light enforcement power. the case demonstrated that International health law is largely non binding and ineffective in ensuring timely compliance

v) AI surveillance in xinjiang, china

Chinese authorities used AI and biometric Technologies Isabel and repressed the Uyghur Muslim population. Despite clear human rights violations, no international legal enforcement followed. The case related to the inability of existing human rights law to address state misuse of emerging Technologies for mass surveillance and control.

vi) Autonomous drones in Libya (2020)

The UN report revealed that a Turkish made AI drone may have conducted autonomous Lethal operations in Libya. This incident occurred without human command with no legal consequences. It exposes the failure of international humanitarian law to address or regulate leases autonomous weapon systems (laws) in conflict zones.

vii) U.S. rejection of the ICC

The United States withdrew from the International Criminal Court ICC and passed laws to prevent the prosecution of its citizens. This undermines the ICC's universality and demonstrates how powerful Nations can avoid International accountability, beginning the very foundation of international criminal enforcement.

viii) Rohingya genocide in Myanmar

Myanmar's military conducted systematic violence against the Rohingya, leading to a Refugee crisis. Although the ICC and UN documented abuses, no decisive legal action followed due to geopolitical vetoes in the UN Security Council. This case underscores how enforcement and international human rights and humanitarian law is easily blocked by political interests.

ix) Annexation of Crimea by Russia

Russia's annexation of Crimea validates the UN charter and international law on sovereignty. Yet the international community could not enforce territorial integrity or reverse the annexation. The case illustrates the limits of international law and powerful States define Global norms without facing legal consequences.

6. COMPLIANCE AND REFORM IDEAS

i) Strengthen enforcement through binding instruments

One of the primary weaknesses in international law is its reliance on non binding instruments which lack the necessary enforceability. Existing frameworks like WHO's health regulations and UNESCO's AI principles remain aspirational, with minimal consequences for non compliance. There is a critical need to convert these into binding legal instruments with clearly articulated obligations and penalties. For this International treaties should incorporate compliance review mechanisms, inspired by successful models such as WTO dispute settlement body, search mechanisms would allow for the review of state behaviour, third party complaints, and sanctions for violations. States should also be legally required to submit compliance reports and be subject to periodic independent reviews to ensure transparency and enforcement.

ii) Developing a global cyber security convention

Cyber attacks like NotPetya and STUXNET have demonstrated the inadequacy of

existing International norms in addressing cyber warfare. There is a pressing need for a United Nations led cyber security convention that defines state behaviour in cyberspace, establishes attribution protocols, and prescribes actionable remedies. This convention should be backed by the creation of an international cyber tribunal to adjudicate state and non state actions involving cross border cyber operations. Additionally a UN Cyber attribution Centre should be established to investigate cyber incidents and determine liability using a neutral, evidence based approach. These reforms would not only deterministic behaviour but also promote accountability in an otherwise unregulated domain.

iii) International regulation on emerging bio technologies

Biotechnologies like gene editing and synthetic biology present unprecedented ethical and safety concerns. The case of CRISPR edited babies in China reviews a global governance vacuum in this domain. To address this, the international community must establish a UN convention for Human Genome editing and bioethics, led jointly by WHO, UNESCO, and the UN office on drugs and crime UNODC. This duty should mandate the registration of all human gene editing projects, require ethical clearance by independent International boards, and enable global bans or suspensions of dangerous research. a global bioethics oversight panel should also be created to monitor compliance and issue public report on violations

iv) Regulating AI and Autonomous weapons

The unregulated development and deployment of AI specially for military purposes poses a major risk to global stability. incidents involving autonomous drones and AI surveillance systems, set as in Libya and Xinjiang, reveal the absence of legal restrictions. a United Nations charter on responsible AI use must be negotiated, setting clear limitations on the development of Lethal autonomous weapons systems (LAWS) and AI based surveillance tools. The Charter should be complemented by a global Moratorium on the use of autonomous weapons until a regulatory Regime is in place. Additionally, States must conduct AI impact assessments Before deploying any age that affects public welfare, privacy or human rights.

v) Reforming international criminal and human rights law enforcement

The international Criminal Court and United Nations Human rights council openly fall

short of delivering justice due to political Indifference, specially from Veto powers in the UN Security Council. To reform this a mechanism should be introduced allowing the UN General Assembly to refer cases to the ICC when the Security Council is deadlocked. they should prevent geopolitical interests from obstructing justice in clear cases of genocide or crimes against humanity. Hybrid codes such as those established for Rwanda on the and for the former Yugoslavia, should be revived as alternatives when the ICC is composed. These codes can be empowered to function regionally or ad hoc ensuring justice even in politically sensitive situations.

vi) Expanding technological capacity in legal institutions

Many international institutions like the technological expertise necessary to effectively regulate modern threats. The ICC, UNHRC, WHO, and others must build internal capacity by establishing specialised Digital forensic units and AI or cyber divisions. These bodies would be responsible for investigating violations, collecting digital evidence, and preparing cases for prosecution. Moreover, capacity building programs must be launched to train diplomats, judges and legal professionals in technology law, forensic methods, and digital evidence assessment. Without this institutional modernization, international law will remain out page by the very Technologies it seeks to regulate.

7. CONCLUSION

The rapid advancement of technology has significantly outpaced the evolution of international law, creating profound executional gaps across various domains such as cyber warfare, artificial intelligence, biotechnology, and space law. existing legal frameworks often like enforceability, clarity, and the necessary institutional capacity to address these challenges. The failure of international bodies to respond effectively to high profile incidents from the Notpetya cyber attack to the use of autonomous drones underscores the agency of legal reform. To bridge these gaps the international community must adopt an approach involving the development of binding treaties, the creation of specialised enforcement bodies and anti-modernisation of legal institutions. equally important is the inclusion of private and non state actors in governance structures, ensuring that law keeps space within innovation. strengthening Global cooperation and fostering cross-sectoral engagement are essential to uphold justice, accountability, and Human Rights in the digital age. without proactive and coordinated reform, the legitimacy and relevance of international law risk further erosion in the face of future technological

disruptions.

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