State Responsibility for Artificial Intelligence-Based Autonomous Weapons: An Analysis of the Integration of International Humanitarian Law and Economics in the Russia-Ukraine Conflict

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Abstract

This study aims to examine the shortcomings of the current regime governing state responsibility for the use of LAWS and to reconstruct the accountability framework through the integration of International Humanitarian Law and Economic approaches. This study employs normative legal research using legal, conceptual, case studies, and Law and Economics approaches. The primary legal materials consist of international treaties, the Draft Articles on State Responsibility for Wrongful Acts at the International Level, and relevant International Humanitarian Law (IHL) instruments, while secondary materials come from scientific literature and reports issued by international organizations. The findings indicate that the existing IHL regime is still largely human-centric and therefore cannot adequately accommodate autonomous decision-making by AI-based weapon systems. While autonomous weapon systems enhance military operational efficiency, they simultaneously create significant legal uncertainty, institutional risks, and substantial socio-economic costs. According to the World Bank's Rapid Damage and Needs Assessment (RDNA4), the conflict has caused approximately US$176 billion in direct physical damage and an estimated US$524 billion in recovery and reconstruction needs, demonstrating that the economic burden of modern warfare extends far beyond the battlefield. From a Law and Economics perspective, although LAWS increase military efficiency, they simultaneously generate institutional uncertainty, transaction costs, negative externalities, moral hazard, and significant economic losses that outweigh their private military benefits. This study proposes a reconstructed state responsibility framework by integrating International Humanitarian Law with Law and Economics, emphasizing meaningful human control, legal certainty, state accountability, and global AI governance as fundamental pillars for regulating autonomous weapons systems.

Keywords: Artificial Intelligence; Lethal Autonomous Weapon Systems; International Humanitarian Law; State Responsibility; Law and Economics.

1. Introduction

The armed conflict between the Russian Federation and Ukraine, which escalated in February 2022, has significantly transformed the contemporary international political order and security architecture. Beyond its geopolitical consequences, the conflict has become the largest

battlefield demonstrating the operational deployment of Lethal Autonomous Weapon Systems (LAWS) in modern warfare[1]. The extensive use of autonomous and semi-autonomous military technologies illustrates that Artificial Intelligence (AI) has moved beyond experimental research and has become an integral component of military operations, fundamentally changing the character of armed conflict[2]. LAWS represent weapon systems equipped with artificial intelligence capable of independently identifying, selecting, and engaging targets through sophisticated sensors, machine learning algorithms, and autonomous decision-making processes. Unlike conventional weapons, these systems can execute critical combat functions with little or no direct human intervention during the engagement cycle[3]. Reports from the Russia–Ukraine conflict indicate that AI-enabled drones and loitering munitions have increasingly demonstrated autonomous navigation, target recognition, and attack capabilities, thereby reducing the role of human operators in real-time battlefield decisions[4].

The emergence of LAWS raises profound legal questions concerning the applicability of existing International Humanitarian Law. Central to this debate is the issue of state responsibility when autonomous weapon systems unlawfully kill civilians or violate fundamental principles of armed conflict. Traditional legal doctrines governing state responsibility were developed on the assumption that internationally wrongful acts are committed by identifiable human actors operating under a state's authority. However, autonomous weapon systems challenge this assumption because decisions may be generated through complex algorithms that function independently once activated. Consequently, determining legal responsibility among military commanders, political leaders, software developers, manufacturers, and states becomes increasingly difficult. The deployment of LAWS also raises concerns regarding compliance with the three fundamental principles of International Humanitarian Law: distinction, proportionality, and precaution[5]. Autonomous systems may encounter significant limitations in distinguishing combatants from civilians in dynamic battlefield environments characterized by uncertainty, incomplete information, and rapidly changing operational conditions. Unlike human decision-makers, AI systems lack contextual understanding, moral judgment, and ethical reasoning, thereby increasing the risk of unlawful attacks against protected persons and civilian objects.

Beyond legal implications, the integration of Artificial Intelligence into military operations has transformed the economics of warfare. AI-based weapon systems have shifted military competition from labor-intensive warfare toward technology-intensive warfare, emphasizing innovation, computational capability, and data superiority as strategic assets. While LAWS may reduce operational costs by minimizing troop deployment and improving targeting efficiency, they simultaneously generate substantial economic costs through research and development expenditures, cybersecurity requirements, institutional uncertainty, and post-conflict

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[1] Justin Lynch, "Are 'Killer Robots' the Future of War?," *Al Jazeera*, 16 Mei 2023, https://www.aljazeera.com/features/2023/5/16/are-killer-robots-the-future-of-war

[2] Dwi Imroatus Sholikah, "Lethal Autonomous Weapon System Dilihat dari Hukum Humaniter Internasional," *Jurnal Bedah Hukum* 7, no. 2 2023, https://ejournal.uby.ac.id/index.php/jbh/article/view/925/397

[3] Dwi Imroatus Sholikah, "Lethal Autonomous Weapon System Dilihat dari Hukum Humaniter Internasional," *Jurnal Bedah Hukum* 7, no. 2 2023, https://ejournal.uby.ac.id/index.php/jbh/article/view/925/397

[4] Al Jazeera, "Drones Have Shaped the Ukraine War. Are 'Killer Robots' Far Off?," *Al Jazeera*, 13 Januari 2023, https://www.aljazeera.com/podcasts/2023/1/13/drones-have-shaped-the-ukraine-war-are-killer-robots-far-off

[5] BBC News, "How AI and Drones Are Changing Warfare in Ukraine," *BBC News*, diakses 29 Mei 2026, https://www.bbc.com/news/videos/cw4y2mrp4jwo

reconstruction. Moreover, the Russia–Ukraine conflict demonstrates that AI-enabled warfare imposes extensive social costs extending beyond the parties to the conflict, including disruptions to global energy markets, food security, international trade, and financial stability.

Although numerous studies have examined the legality of autonomous weapon systems from the perspective of International Humanitarian Law, relatively few have integrated legal analysis with economic theory to evaluate whether the deployment of LAWS is socially efficient once legal uncertainty and external costs are fully considered. This study addresses that gap by combining International Humanitarian Law with the analytical framework of Law and Economics to evaluate both the legal accountability and the economic consequences of autonomous weapon systems. Accordingly, this study seeks to: (1) examine the use of LAWS in the Russia–Ukraine armed conflict as a contemporary issue of International Humanitarian Law; (2) identify the international actors involved in the development and deployment of autonomous weapon systems; (3) analyze the challenges of enforcing state responsibility under existing international legal frameworks; and (4) evaluate the economic implications of LAWS through the perspective of Law and Economics in order to propose a reconstructed framework of state responsibility capable of addressing emerging challenges posed by Artificial Intelligence in modern armed conflict.

2.1. Lethal Autonomous Weapon Systems (LAWS) as an Emerging Issue in International Humanitarian Law

The rapid advancement of Artificial Intelligence (AI) has fundamentally transformed the nature of contemporary armed conflicts by introducing autonomous technologies capable of performing military functions that were traditionally executed by human combatants. Among these innovations, Lethal Autonomous Weapon Systems (LAWS) represent one of the most controversial developments because they possess the capability to independently identify, select, track, and engage military targets without continuous human intervention. The integration of machine learning, computer vision, sensor fusion, and autonomous decision-making algorithms has enabled these systems to operate in increasingly complex battlefield environments. Consequently, the emergence of LAWS has challenged the adequacy of existing international legal frameworks governing the conduct of hostilities. Although no universally accepted legal definition of LAWS currently exists, the Convention on Certain Conventional Weapons (CCW) under the auspices of the United Nations generally describes autonomous weapon systems as weapons capable of selecting and engaging targets after activation without further human control. This definition reflects the growing concern that autonomous systems may exercise significant decision-making authority over the use of lethal force. The debate surrounding LAWS therefore extends beyond technological innovation to encompass fundamental legal, ethical, and humanitarian considerations regarding the delegation of life-and-death decisions to machines.

The deployment of AI-enabled military technologies in the Russia–Ukraine armed conflict illustrates that autonomous capabilities are no longer hypothetical concepts but operational realities. Various forms of autonomous and semi-autonomous drones have been employed for reconnaissance, surveillance, target acquisition, loitering attacks, and precision strikes[6]. Although many currently deployed systems still involve varying degrees of human supervision, continuous

[6] "Lancet-3 Loitering Munition Kamikaze Drone Russia Data Fact Sheet," *Army Recognition*, tersedia pada Army Recognition

advances in AI suggest that future weapon systems may achieve substantially higher levels of autonomy. This technological trajectory raises significant concerns regarding compliance with International Humanitarian Law (IHL), particularly when autonomous systems make targeting decisions in highly dynamic and uncertain operational environments. International Humanitarian Law regulates the conduct of hostilities through several fundamental principles, namely distinction, proportionality, military necessity, and precaution. These principles require combatants to distinguish military objectives from civilian persons and objects, ensure that anticipated civilian harm is not excessive in relation to the expected military advantage, employ force only when necessary to achieve legitimate military objectives, and take all feasible precautions to minimize incidental civilian casualties[7]. Compliance with these principles has traditionally depended upon human judgment, contextual understanding, and ethical reasoning exercised by military commanders and combatants.

The increasing autonomy of AI-based weapon systems challenges these foundational assumptions. Unlike human decision-makers, AI systems operate through computational models trained on historical datasets and algorithmic pattern recognition. While these technologies may achieve remarkable accuracy under controlled conditions, they remain vulnerable to errors arising from incomplete information, adversarial manipulation, sensor failures, algorithmic bias, and unforeseen battlefield conditions. Such limitations raise legitimate concerns regarding the capacity of autonomous systems to reliably distinguish civilians from lawful military targets or to perform proportionality assessments that require complex legal and moral evaluations. From a legal perspective, the use of LAWS also exposes significant gaps within existing international legal regimes. The Geneva Conventions of 1949 and Additional Protocol I of 1977 were drafted on the assumption that decisions concerning the use of force would remain under meaningful human control[8]. Accordingly, the legal concepts of individual criminal responsibility, command responsibility, and state responsibility are fundamentally based upon identifiable human conduct. When autonomous weapon systems independently execute lethal actions after activation, determining whether responsibility should be attributed to military commanders, political leaders, software developers, manufacturers, or the deploying state becomes substantially more complicated. This phenomenon has been widely described as the responsibility gap, referring to situations in which harmful outcomes generated by autonomous systems cannot easily be attributed to a legally accountable actor[9]. The responsibility gap has become one of the central issues discussed within the Group of Governmental Experts (GGE) on LAWS established under the CCW framework. Numerous states have emphasized the necessity of preserving Meaningful Human Control (MHC) over critical targeting decisions to ensure that accountability remains attributable to human decision-makers. Nevertheless, no legally binding international instrument currently establishes minimum standards regarding the permissible level of autonomy in weapon systems or clearly allocates legal responsibility when autonomous systems violate International Humanitarian Law.

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[7] Marco Sassòli, "Autonomous Weapons and International Humanitarian Law: Advantages, Open Technical Questions and Legal Issues to be Clarified," *International Law Studies* Vol. 90 2014

[8] Protocol Additional to the Geneva Conventions of 12 August 1949, and Relating to the Protection of Victims of International Armed Conflicts (Protocol I), 8 Juni 1977, Pasal 36

[9] Robert Sparrow, "Killer Robots," Journal of Applied Philosophy 24, no. 1 2007

The emergence of LAWS also raises broader concerns regarding international peace and security. Autonomous weapon systems have the potential to reduce military casualties among deploying states, increase operational speed, and expand strategic capabilities. However, these perceived military advantages may simultaneously lower the political costs associated with initiating armed conflict, thereby increasing the likelihood of military intervention and accelerating the global AI arms race. As military competition increasingly shifts toward algorithmic superiority, technological innovation, and autonomous decision-making capabilities, the absence of comprehensive international regulation may undermine both humanitarian protection and international stability. Accordingly, the development of LAWS should not be regarded merely as a technological innovation but as a multidimensional legal challenge requiring the reconstruction of existing accountability frameworks. The evolution of autonomous warfare demonstrates that traditional principles of International Humanitarian Law remain indispensable; however, their implementation must be adapted to address emerging forms of artificial intelligence capable of exercising functions previously reserved for human judgment. This transformation necessitates an integrated regulatory framework that combines legal accountability, meaningful human control, technological transparency, and effective international governance to ensure that advances in military AI remain consistent with the humanitarian objectives underlying International Humanitarian Law.

2.2. Economic Dimension of the Use of Lethal Autonomous Weapon Systems (LAWS) in the Russia–Ukraine Conflict: A Law and Economics Perspective

The development of Lethal Autonomous Weapon Systems (LAWS) in the Russia–Ukraine armed conflict demonstrates that the transformation of military technology is no longer merely an issue of international law but has evolved into a strategic economic phenomenon affecting production structures, investment, trade, and global governance. The integration of Artificial Intelligence (AI) into weapon systems marks a paradigm shift in warfare from labour-intensive warfare to technology-intensive warfare. This transformation has shifted the source of military superiority from one primarily based on the number of personnel and conventional military power to one driven by algorithms, data, computational capabilities, and technological innovation. From the perspective of Law and Economics, the use of LAWS should not be viewed merely as an innovation in defense technology but rather as a form of technology capital investment that simultaneously generates economic, legal, and institutional consequences. The endogenous growth theory developed by Paul Romer identifies innovation as the primary driver of long-term productivity growth. Unlike neoclassical growth theory, which regards technological progress as an exogenous factor, endogenous growth theory explains that investment in Research and Development (R&D), education, and knowledge accumulation constitutes the principal determinant of a country's economic growth. Within the context of the defense industry, the development of LAWS represents a strategic investment that not only enhances the effectiveness of military operations but also strengthens the competitiveness of the national defense industry through the mastery of artificial intelligence, machine learning, big data analytics, satellite navigation systems, and cloud computing technologies.

This transformation demonstrates that military technology has become an integral component of the knowledge-based economy, in which the production and utilization of knowledge constitute the primary source of added value. States possessing strong research

capabilities gain a comparative advantage in the development of the defense industry, thereby improving production efficiency while simultaneously strengthening their geopolitical position. This condition explains why the Russia–Ukraine conflict has been accompanied by substantial increases in investment in artificial intelligence, semiconductors, military communication systems, and satellite technologies by numerous countries, particularly NATO member states. Consequently, modern warfare not only generates military competition but also accelerates the global innovation race, which directly influences the structure of the global economy. From the perspective of defense economics, the use of LAWS fundamentally transforms the cost structure of warfare. The costs of war are no longer dominated by personnel expenditures, logistics, and troop mobilization but have shifted toward technological investments characterized by high fixed costs and relatively low marginal operating costs. Artificial intelligence-based weapon systems are capable of conducting surveillance, target identification, navigation, and attacks autonomously, thereby reducing personnel requirements on the battlefield and lowering long-term logistical costs. These efficiencies increase military operational productivity through faster decision-making, greater targeting accuracy, and reduced casualties among operators. However, such economic efficiency must be comprehensively assessed through a cost–benefit analysis approach. The development of LAWS requires substantial investment in research and development, computational infrastructure, cybersecurity systems, artificial intelligence software, algorithm testing, and the establishment of a high-technology industrial ecosystem. These expenditures do not yet include the risks associated with algorithmic failure, target misidentification, and cyberattacks, all of which may generate significant economic and legal losses. Therefore, the operational efficiency produced by LAWS does not automatically result in economic efficiency unless all investment costs, maintenance costs, security expenditures, and legal risks are comprehensively taken into account.

Institutional economics provides a broader perspective on the relationship between the development of Lethal Autonomous Weapon Systems (LAWS) and the quality of global governance. Douglass North argues that institutions constitute a set of formal and informal rules that determine the efficiency of economic activities by reducing uncertainty. In the context of LAWS, the absence of a specific international legal instrument governing the development, deployment, and accountability mechanisms of autonomous weapon systems creates institutional uncertainty. This uncertainty increases transaction costs because states and corporations must bear the risks associated with regulatory changes, international sanctions, litigation, and declining investor confidence in the artificial intelligence-based defense industry. From the perspective of Law and Economics, legal uncertainty represents a form of economic inefficiency. The lower the level of legal certainty regarding the use of LAWS, the greater the economic costs that must be borne by states, technology companies, and investors. This condition demonstrates that the effectiveness of international regulation serves not only as an instrument of legal protection but also as a mechanism for enhancing market efficiency by reducing investment risks and increasing the predictability of economic activities.

In addition to generating internal efficiencies for deploying states, the use of LAWS also produces various negative externalities that are not fully borne by the principal actors. The Russia–Ukraine conflict demonstrates that the use of modern military technologies has contributed to rising energy prices, disruptions to global supply chains, food inflation, declining international trade, and increasing uncertainty in global financial markets. The disruption of wheat exports from

the Black Sea region, together with the volatility of oil and natural gas prices, illustrates that the economic consequences of the conflict are no longer confined to the local level but have spread through international trade mechanisms and global commodity markets. From the perspective of welfare economics, the social costs arising from the use of LAWS substantially exceed the private costs incurred by the deploying state. The destruction of civilian infrastructure, the increase in the number of refugees, the loss of labor productivity, the decline in foreign direct investment, and the growing fiscal burden associated with post-conflict reconstruction constitute externalities that must ultimately be borne by the international community. Therefore, the technological efficiency achieved through the deployment of LAWS cannot serve as the sole indicator of success when it generates social losses that significantly outweigh its economic benefits.

Data published by the World Bank, the United Nations Development Programme (UNDP), and the European Commission indicate that the Russia–Ukraine armed conflict has resulted in direct damage amounting to approximately US$195.1 billion, recovery and reconstruction needs estimated at approximately US$588 billion over the next ten years, and total socio-economic losses of approximately US$667 billion.

Type of Loss	Estimated Value (USD)	Description
Direct Damage	US$176 billion	Damage to residential buildings, roads, bridges, ports, energy infrastructure, schools, and hospitals (as of 31 December 2024).
Socio-economic Losses	US$589 billion	Losses in economic activity, income, production, employment, public services, and broader economic disruption resulting from the war.
Recovery and Reconstruction Needs	US$524 billion	Estimated funding required to rebuild Ukraine over a ten-year period following the 2025 assessment.

From the perspective of Law and Economics, these figures demonstrate that the economic costs of war extend far beyond physical destruction. Direct damage amounting to US$176 billion represents only the loss of tangible assets, including infrastructure, housing, energy facilities, and public services. By contrast, total socio-economic losses ranging from approximately US$589 billion to US$667 billion encompass declining economic output, reduced productivity, unemployment, disruptions to international trade, inflationary pressures, and declining investment. These findings indicate that the social costs of war substantially exceed the private costs incurred by the belligerent states. Consequently, the use of military technologies, including LAWS, cannot be evaluated solely on the basis of operational efficiency but must also be assessed in terms of their broader implications for global economic welfare and sustainable development. Another economic dimension that deserves attention is the emergence of moral hazard in international relations. The reduction in the risk of military personnel casualties resulting from the deployment of autonomous weapon systems has the potential to lower the political constraints faced by states when resorting to military force as an instrument for resolving international disputes. The lower the domestic political costs associated with military casualties, the greater the likelihood that governments will decide to undertake armed intervention. This phenomenon creates a perverse

incentive, whereby technological innovation inadvertently increases the probability of future rmed conflicts.

From the perspective of public economics, increasing investment in artificial intelligence-based defense industries also gives rise to the issue of opportunity cost. Every increase in military expenditure reduces the government's fiscal capacity to finance education, healthcare, social protection, and infrastructure development. Consequently, the AI arms race has the potential to generate allocative inefficiency, as a significant proportion of public resources is redirected toward the defense sector rather than to sectors that more directly contribute to public welfare and long-term economic development. The foregoing analysis demonstrates that the deployment of LAWS creates a reciprocal relationship between technological efficiency, legal risk, and social costs. From the perspective of Law and Economics, autonomous weapon systems can only be regarded as economically efficient if their economic benefits exceed both the private costs and the social costs that they generate. Therefore, the assessment of LAWS should not be limited solely to their military effectiveness but must also take into account legal certainty, the protection of human rights, global economic stability, sustainable development, and the quality of international governance.

Accordingly, the reconstruction of state responsibility for the use of artificial intelligence in armed conflict should be directed toward the establishment of an international legal regime that integrates the principles of International Humanitarian Law with the Law and Economics approach. Such an integrated framework would ensure that military technological innovation remains within the boundaries of economic efficiency, legal accountability, and the protection of the fundamental interests of humanity at the global level.

2.3. State Responsibility for the Use of Lethal Autonomous Weapon Systems under International Humanitarian Law

State responsibility constitutes one of the fundamental principles of international law, serving as the legal basis for holding states accountable for internationally wrongful acts committed through their organs, agents, or entities acting under their authority or control. Within the framework of International Humanitarian Law (IHL), state responsibility ensures that violations committed during armed conflicts generate legal consequences, including the obligation to cease the wrongful conduct, provide reparations, and guarantee non-repetition. However, the emergence of Artificial Intelligence (AI)-enabled weapon systems has fundamentally challenged the traditional doctrine of state responsibility because autonomous technologies increasingly perform functions that were previously reserved for human decision-makers. The legal foundation of state responsibility is primarily established in the Draft Articles on Responsibility of States for Internationally Wrongful Acts (ARSIWA) adopted by the International Law Commission in 2001[10]. Article 2 of ARSIWA provides that an internationally wrongful act exists when conduct attributable to a state constitutes a breach of an international obligation. Accordingly, two essential elements must be established: first, the conduct must be attributable to the state; second, such

[10] International Law Commission, "Draft Articles on Responsibility of States for Internationally Wrongful Acts, with Commentaries," 2001

conduct must violate an international legal obligation. In conventional armed conflicts, these elements can generally be established without significant difficulty because military operations are conducted directly by state organs, members of the armed forces, or individuals acting under governmental authority.

The increasing deployment of Lethal Autonomous Weapon Systems (LAWS), however, complicates this attribution process. Unlike conventional weapons, autonomous systems possess the capacity to process environmental data, identify potential targets, evaluate operational conditions, and execute lethal force through algorithmic decision-making processes after activation. Although states remain responsible for authorizing the deployment of such systems, the immediate operational decisions may be generated independently by artificial intelligence. Consequently, determining whether the resulting conduct should be attributed solely to the deploying state, military commanders, software developers, manufacturers, or other actors has become one of the most contested issues in contemporary international law. From the perspective of International Humanitarian Law, states remain legally bound by the core principles governing the conduct of hostilities, irrespective of the technological sophistication of the weapons employed. The principles of distinction, proportionality, precaution, and military necessity continue to apply to autonomous weapon systems in the same manner as to conventional weapons. Therefore, the use of LAWS does not exempt states from their obligations to ensure that military operations comply with the Geneva Conventions of 1949 and Additional Protocol I of 1977. Nevertheless, the practical implementation of these principles becomes increasingly problematic when critical battlefield decisions are delegated to autonomous algorithms that lack human judgment, contextual reasoning, and ethical deliberation.

The principle of distinction illustrates this challenge most clearly. Autonomous systems rely primarily on computational models trained through machine learning techniques to classify objects and individuals based on observable characteristics. While these systems may demonstrate high levels of technical accuracy under controlled operational conditions, they remain incapable of fully understanding complex humanitarian contexts involving surrendering combatants, wounded personnel, civilians directly participating in hostilities, or rapidly changing battlefield circumstances. Consequently, algorithmic errors may result in unlawful attacks against protected persons, thereby constituting violations of International Humanitarian Law.

Similarly, compliance with the principle of proportionality presents significant legal difficulties. Proportionality assessments require military commanders to balance the anticipated military advantage against the expected incidental civilian harm before launching an attack. Such evaluations inherently involve qualitative legal judgments, moral reasoning, and contextual interpretation that cannot be entirely reduced to computational calculations. Current AI technologies remain incapable of independently performing these normative evaluations with the level of discretion expected under International Humanitarian Law. As a result, the delegation of proportionality assessments to autonomous systems raises serious concerns regarding the legality of fully autonomous targeting decisions. These legal challenges have generated what scholars commonly describe as the responsibility gap. The responsibility gap refers to situations in which harmful consequences produced by autonomous weapon systems cannot easily be attributed to any legally accountable human actor despite the occurrence of internationally wrongful acts. This gap emerges because existing legal doctrines presume that decisions involving the use of lethal force

originate from identifiable individuals exercising conscious judgment. When autonomous systems independently determine targeting decisions after activation, traditional concepts such as command responsibility, individual criminal responsibility, and state responsibility become increasingly difficult to apply.

The doctrine of command responsibility, which has long served as a cornerstone of international criminal law, also encounters significant limitations in the context of LAWS. Under established jurisprudence, military commanders may incur criminal responsibility when they knew or should have known that their subordinates were committing international crimes and failed to prevent or punish such conduct. However, autonomous weapon systems cannot be characterized as legal persons or military subordinates. Consequently, commanders may argue that they neither intended nor directly controlled the algorithmic decisions leading to unlawful attacks. This legal ambiguity weakens the effectiveness of existing accountability mechanisms and creates uncertainty regarding the allocation of responsibility. In response to these challenges, international discussions under the Convention on Certain Conventional Weapons (CCW) have increasingly emphasized the principle of Meaningful Human Control (MHC). The concept requires that human operators retain sufficient involvement in critical functions relating to target selection and the use of lethal force. Meaningful Human Control seeks to preserve legal accountability by ensuring that autonomous technologies remain subject to effective human supervision throughout the decision-making process. Nevertheless, despite extensive discussions within the Group of Governmental Experts (GGE) on LAWS, no universally accepted definition or legally binding international instrument currently specifies the minimum level of human control required for autonomous weapon systems.

Beyond legal attribution, the deployment of LAWS also raises broader governance concerns. The absence of internationally harmonized regulatory standards has encouraged divergent national approaches regarding the development, acquisition, and operational deployment of autonomous weapons. Such regulatory fragmentation increases legal uncertainty, complicates international cooperation, and accelerates the global competition for military AI capabilities[11]. Consequently, the lack of a comprehensive legal framework not only undermines humanitarian protection but also threatens international peace and security by facilitating an uncontrolled technological arms race.

Accordingly, the existing doctrine of state responsibility requires substantial reconstruction to address the realities of AI-enabled warfare. Rather than relying exclusively on traditional attribution principles developed for conventional military operations, future regulatory frameworks should adopt a multidimensional accountability model integrating state responsibility, command responsibility, corporate accountability, algorithmic transparency, and mandatory meaningful human control. Such an integrated approach would strengthen legal certainty while ensuring that advances in artificial intelligence remain consistent with the humanitarian objectives underlying International Humanitarian Law.

[11] Al Jazeera, "Russia Uses AI-Powered Drones in Ukraine as Part of Autonomous Arms Race," Al Jazeera 2024 https://www.aljazeera.com/news/2024/1/17/russia-ukraine-ai-drones

2.4 Challenges and Reconstruction of International Legal Regulation for Artificial Intelligence-Based Autonomous Weapon Systems

The rapid evolution of Artificial Intelligence (AI) has outpaced the development of international law governing the conduct of armed conflict. While International Humanitarian Law (IHL) has historically demonstrated remarkable adaptability to technological changes in warfare, the emergence of Lethal Autonomous Weapon Systems (LAWS) presents unprecedented regulatory challenges that existing legal instruments were never designed to address. Unlike conventional weapons, autonomous systems possess the capacity to perform critical combat functions independently through algorithmic decision-making processes, thereby blurring the boundaries between human agency, technological autonomy, and legal accountability. Consequently, the principal challenge facing contemporary international law is not merely determining whether LAWS are lawful, but rather whether existing legal frameworks remain adequate to regulate autonomous decision-making in armed conflict. One of the most significant legal challenges concerns the absence of a universally accepted legal definition of LAWS. Despite extensive deliberations within the framework of the Convention on Certain Conventional Weapons (CCW), the international community has yet to reach consensus regarding the level of autonomy that transforms an automated weapon into a fully autonomous weapon system[12]. States continue to adopt divergent interpretations concerning the scope of autonomy, ranging from systems operating under continuous human supervision to platforms capable of independently selecting and engaging targets after activation. This definitional ambiguity creates regulatory fragmentation and hinders the establishment of uniform legal standards applicable to autonomous military technologies.

The second challenge relates to the fragmentation of international legal obligations. Existing International Humanitarian Law was developed to regulate human conduct during armed conflict rather than autonomous technological processes. The Geneva Conventions of 1949, Additional Protocol I of 1977, and customary international humanitarian law impose obligations upon states and individuals but do not specifically regulate algorithmic decision-making, machine learning, adaptive software, or autonomous targeting systems. As a consequence, current legal norms must be interpreted analogically to address technological developments that were inconceivable at the time these treaties were negotiated. Such interpretative extensions inevitably generate legal uncertainty concerning the applicability of established humanitarian principles to AI-enabled warfare. A further challenge arises from the increasing complexity of algorithmic accountability. Unlike conventional military decisions, AI systems rely upon sophisticated computational models trained using large datasets and continuously optimized through machine learning techniques. In many circumstances, the internal reasoning process of advanced AI algorithms cannot be fully explained even by their developers, producing what is commonly referred to as the "black box" phenomenon. This lack of algorithmic transparency complicates judicial review, forensic investigation, and legal attribution when autonomous systems produce unlawful outcomes. Consequently, establishing causation between algorithmic decisions and

[12] Resolusi Majelis Umum PBB A/RES/77/209 (2022), "Lethal Autonomous Weapons Systems," Komite Pertama PBB.

internationally wrongful acts becomes considerably more difficult than under traditional military command structures.

The emergence of private technology companies as principal developers of military AI further complicates the legal landscape. Historically, the development and production of military equipment were primarily undertaken by state-owned industries operating under direct governmental supervision. Contemporary AI technologies, however, are increasingly designed by private corporations specializing in artificial intelligence, cloud computing, semiconductors, cybersecurity, and autonomous robotics. These corporations frequently collaborate with governments through procurement contracts while simultaneously operating within global commercial markets. The resulting diffusion of technological responsibility creates uncertainty regarding the allocation of liability among states, military operators, software developers, hardware manufacturers, and private contractors. Existing international law remains largely silent regarding the direct international legal obligations of these non-state actors in relation to autonomous weapon systems[13].

Another important legal concern involves the absence of binding international governance mechanisms. Although the Group of Governmental Experts (GGE) on LAWS has produced a series of guiding principles emphasizing human responsibility, accountability, and compliance with International Humanitarian Law, these principles remain politically persuasive rather than legally binding. Unlike treaties prohibiting chemical weapons, biological weapons, or anti-personnel landmines, there is currently no comprehensive international convention specifically regulating the development, deployment, export, or operational use of autonomous weapon systems. Consequently, regulatory approaches vary considerably among states, increasing the likelihood of normative fragmentation and technological competition.

The Russia–Ukraine armed conflict has further demonstrated that AI-enabled military technologies are evolving more rapidly than international regulatory responses. Autonomous 5s, loitering munitions, intelligent surveillance systems, and AI-assisted command platforms have become integral components of contemporary military operations. Their operational success has encouraged numerous states to accelerate investments in autonomous defense technologies, thereby intensifying the global AI arms race. Without effective international regulation, technological competition may gradually lower political constraints on the use of force and increase the frequency of autonomous military operations. From a broader governance perspective, these legal deficiencies reflect the limitations of a predominantly human-centered regulatory paradigm. Traditional doctrines of International Humanitarian Law presume that legal accountability flows from identifiable human intentions and decisions. Autonomous weapon systems challenge this assumption by introducing algorithmic agents capable of independently executing lethal functions within predefined operational parameters. Although AI lacks international legal personality, its operational autonomy substantially affects the practical implementation of legal norms governing armed conflict. Accordingly, future regulatory

[13] Campaign to Stop Killer Robots, "Country Views on Killer Robots" 2023, https://www.stopkillerrobots.org/resources/country-views

frameworks must recognize that technological autonomy requires corresponding innovations in legal governance rather than merely extending existing doctrines through analogy.

These challenges indicate that the reconstruction of international legal regulation should extend beyond the traditional doctrine of state responsibility. A comprehensive governance framework should incorporate multiple layers of accountability, including state responsibility for deployment decisions, command responsibility for operational oversight, corporate responsibility for technological safety and transparency, and regulatory oversight concerning algorithmic design, testing, verification, validation, and cybersecurity. Such an approach would ensure that accountability is distributed across all actors participating in the life cycle of autonomous weapon systems.

Furthermore, future international regulation should institutionalize several fundamental principles governing military AI. These include Meaningful Human Control, mandatory legal review of AI-enabled weapon systems prior to deployment, algorithmic transparency, explainability, cybersecurity assurance, independent verification mechanisms, and international monitoring of compliance. Collectively, these principles would strengthen legal certainty while preserving the humanitarian values embedded within International Humanitarian Law. Ultimately, the regulatory challenges posed by LAWS illustrate that contemporary armed conflict has entered a new era in which legal governance must evolve alongside technological innovation. The objective of future international regulation should not be to impede scientific progress but to ensure that advances in Artificial Intelligence remain consistent with the principles of humanity, accountability, legal certainty, and international peace. Accordingly, reconstructing the international legal framework governing autonomous weapon systems constitutes an essential prerequisite for maintaining the legitimacy of International Humanitarian Law in the age of artificial intelligence.

3. Conclusion

The deployment of Lethal Autonomous Weapon Systems (LAWS) in the armed conflict between Russia and Ukraine has demonstrated that AI-enabled weapons are no longer a hypothetical concept of future warfare but have become an operational reality on contemporary battlefields. The use of weapon systems capable of employing lethal force without direct human confirmation of targets raises a fundamental question in international law: Who bears legal responsibility when autonomous weapon systems make erroneous decisions and cause the death of innocent civilians?[14]. The Russia–Ukraine conflict further demonstrates that the deployment of LAWS involves a complex network of actors extending beyond the belligerent states themselves. These actors include states supplying military technology, private defense companies responsible for developing artificial intelligence systems, and international organizations involved in humanitarian protection and international security governance. The multiplicity of actors

[14] Noel Sharkey, "Grounds for Discrimination: Autonomous Robot Weapons," *RUSI Defence Systems* Vol. 11, No. 2 2008

significantly complicates the determination of legal responsibility when autonomous weapon systems commit violations of International Humanitarian Law[15].

The findings of this study indicate that contemporary international law faces significant challenges in regulating the use of autonomous weapon systems. The existing principles of International Humanitarian Law (IHL) were developed on the assumption that decisions concerning the use of force would remain under meaningful human control. Consequently, the emergence of a responsibility gap resulting from the deployment of LAWS poses a serious threat to the effectiveness of the international legal accountability regime. Although International Humanitarian Law continues to provide the normative framework governing the conduct of armed conflict, its existing legal instruments remain insufficient to address the unique characteristics of autonomous decision-making by artificial intelligence.

From the perspective of Law and Economics, the deployment of LAWS also generates significant economic consequences that extend beyond military efficiency. While autonomous weapon systems may improve operational effectiveness and reduce military casualties among deploying states, they simultaneously create institutional uncertainty, increase transaction costs, generate substantial negative externalities, and impose considerable social costs on the international community. The empirical evidence from the Russia–Ukraine conflict demonstrates that the economic burden of modern warfare far exceeds its immediate military benefits, thereby reinforcing the need for legal frameworks capable of internalizing these broader societal costs.

Accordingly, this study argues that reconstructing state responsibility for the use of Artificial Intelligence in armed conflict requires the development of an international legal regime that integrates the principles of International Humanitarian Law with the analytical framework of Law and Economics. Such a framework should establish clear rules on state accountability, ensure meaningful human control over autonomous weapon systems, strengthen algorithmic transparency, and promote international governance capable of balancing technological innovation with humanitarian protection, legal certainty, and sustainable global development. Only through such an integrated approach can international law effectively respond to the legal and economic challenges posed by the increasing deployment of Artificial Intelligence in contemporary armed conflicts.

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