

The Security Implications of Artificial Intelligence (AI)-Powered Autonomous Weapons: Policy Recommendations for International Regulation

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Abstract— *The incorporation of artificial intelligence (AI) into autonomous weapon systems raises significant security concerns and ethical questions regarding international regulation. This paper explores the potential effects of AI-driven autonomous weapons (AI-AWs) on global security, emphasizing the dual-use characteristics of AI technologies and their ability to disrupt military strategies and strategic equilibrium. Through a combination of interdisciplinary workshops, literature reviews, and case studies, the research highlights critical security threats, ethical issues, and the risk of unintended escalation of conflicts linked to AI-AWs. The paper advocates for the creation of comprehensive international policies and regulatory frameworks to tackle these challenges, stressing the importance of human oversight and ethical standards. Policy suggestions include establishing precise definitions, monitoring systems, and international oversight organizations to ensure the responsible use of AI in military applications. The study concludes by calling for global collaboration to reduce the risks associated with AI-AWs and to enhance global security and stability.*

Keywords— *Artificial Intelligence (AI), AI-driven autonomous weapons, international regulation, security concerns, ethical questions, dual-use technologies, strategic equilibrium, human oversight, policy suggestions, global security, military AI.*

I. INTRODUCTION TO AI-DRIVEN AUTONOMOUS WEAPONS

The integration of artificial intelligence (AI) into military technologies necessitates a careful examination of its implications for global security (Araya & King, 2022; Morgan et al., 2020; Brundage et al., 2018; Gilbert & Gilbert, 2024f). An interdisciplinary team of AI experts notes, "Many foreseeable technologies are dual-use in nature and may be harmful when in nonbeneficial hands." AI-powered autonomous weapons (AI-AWs) are particularly viewed as having the potential to disrupt international security (Siregar et al., 2024; Puscas, 2023; Gilbert & Gilbert, 2024c; Yeboah, Opoku-Mensah & Abilimi, 2013a; Kwame, Martey & Chris, 2017). On one hand, various entities could leverage existing artificial intelligence to create AI-AWs, thereby amplifying the already present risks associated with such dual-use technologies. On the other hand, AI technologies provide opportunities to merge kinetic and non-kinetic forces in innovative ways that can challenge established military doctrines and strategic stability (Raska & Bitzinger, 2023;

Abilimi et al., 2015; van Hooft, Boswinkel & Sweijs, 2022; Gilbert & Gilbert, 2024b).

Our diverse academic backgrounds have united us to analyze the potential impacts of AI-AWs on armed conflict and international security (Yeboah, Opoku-Mensah & Abilimi, 2013b). The initial steps of our analysis involve two independent workshops aimed at identifying the challenges that AI-AWs may present and seeking policy recommendations for national governments and the international community as a whole (Siregar et al., 2024; Opoku-Mensah, Abilimi & Boateng, 2013; Christopher, 2013; Gilbert & Gilbert, 2024a). To synthesize the results provided by the participants, an interdisciplinary approach is essential to bridge the technological, ethical, political, legal, and military divides in discussions regarding the potential security implications of these technologies (Hirblinger et al., 2024; Opoku-Mensah, Abilimi & Amoako, 2013; Gilbert & Gilbert, 2024d).

While existing international humanitarian law and ethical frameworks strive to mitigate the harms caused by weapons, there is a growing emphasis among governments and scholars on the necessity for policies and normative frameworks specifically tailored to AI-powered autonomous weapons (AI-AWs) to re-establish the normative order concerning risk reduction and enhanced security (Gilbert & Gilbert, 2024i). These AI systems, "which can independently select targets and, if integrated into weapon systems, deploy them without further control from current human decision-making," are anticipated to emerge due to military research programs conducted by various governments. Advocates and opponents are both advancing their arguments, focusing on the physical characteristics of the weapon systems and the potential strategic advantages that AI could offer in the military domain (Jensen, Whyte & Cuomo, 2022). Despite these vigorous debates, the International Committee of the Red Cross (ICRC) (n.d.) emphasized in their comprehensive report on the regulation of AI-powered autonomous weapons that the AI-human relationship and communication during the processes of acquisition, selection, engagement, and target prescription remain largely unexplored among the general public and political stakeholders (Panic & Arthur, 2024; Sánchez, Bhatia & Pinto, 2023). Furthermore, there is broad consensus on the necessity of maintaining human control in lethal autonomous

weapons systems, yet there is no definitive answer on how this principle should be interpreted and implemented in practice (Amoroso & Tamburrini, 2020; Amoroso & Tamburrini, 2021).

1.1. Research Approach and Methodology

Interdisciplinary Collaboration: The research was carried out by a diverse team of AI specialists, merging insights from fields such as technology, ethics, politics, law, and military studies (Cummings & Guerlain, 2019).

Workshops: Two separate workshops were held to pinpoint challenges and develop policy recommendations, leveraging expert discussions and brainstorming sessions to collect a variety of viewpoints (Dando & Houghton, 2020).

Comprehensive Literature Review: The study encompassed a thorough examination of existing literature to grasp the current

understanding and debates surrounding AI-driven autonomous weapons (Lin, Bekey & Abney, 2012).

Case Studies and Historical Examples: The research incorporated case studies and historical instances to provide empirical evidence and highlight the implications and challenges associated with autonomous weapons (Sharkey, 2014).

Policy Analysis: The paper performed an in-depth analysis of current legal frameworks and suggested new regulatory measures, concentrating on policy recommendations (Asaro, 2012).

Ethical and Legal Analysis: The study explored ethical dilemmas and legal issues, utilizing normative analysis to evaluate the moral and legal ramifications of AI in military contexts (Galliot, 2019). See the diagram in Figure 1.

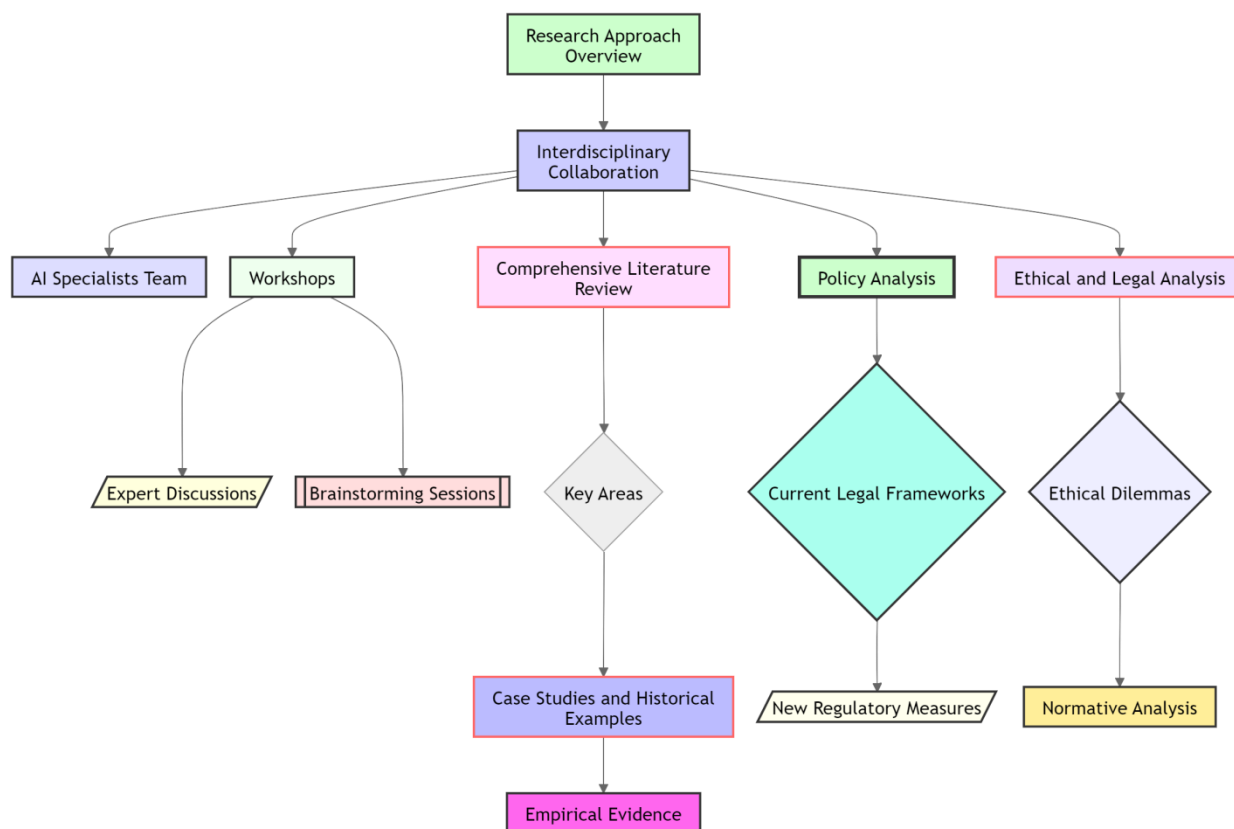


Figure 1: The Research approach of the Security implications of AI

1.2. Definition and Functionality

It is evident that human operators are involved in various capacities in AI-powered autonomy across both military and transportation sectors. In the articles by De La Torre and Choo (2020), and Chamola et al. (2021), Autonomous vehicles can be programmed to respond to situations involving civilians outside of the vehicles and can sometimes perceive each other as local adversaries. Even we humans, whether inside or outside of automated vehicles, have developed new understandings and allocations of spatial and temporal zones (Marcano et al., 2020; Tengilimoglu, Carsten & Wadud, 2023; Feldman et al., 2019). The military application of AI-powered autonomy, particularly involving the most serious and lethal weaponry, should be

required to be as interoperable as possible across different sides of a future or potential conflict. We recognize that accidents and fatalities occur every time we drive our cars, yet we generally believe that the overall tangible and intangible benefits outweigh these costs or risks (Guria, 2020; Machumu, 2018). However, there is no comparable risk-benefit analysis in the case of fusion devices, atomic bombs, dirty bombs, chemical weapons, biological weapons, systems that utilize intentionally created electromagnetic pulses, or killer robots (Brundage et al., 2020).

The varying roles of human operators in autonomous systems present a significant issue for the regulation of both AI-powered autonomous weapons and driverless transportation.

Nevertheless, Ling concluded that rather than debating the meaning of a few letters, it would be more productive to address the actual issues at hand (Bean & Melzer, 2021; Opoku-Mensah, Abilimi & Boateng, 2013; Firlej & Taeihagh, 2020). To begin, Ling draws parallels with human operators involved in warfare. These include drone operators on land and in the air, future operators of underwater vehicles, and, to some extent, even future computer network operators whose primary responsibility is to conduct cybersecurity testing (Yeboah, Odabi & Abilimi, 2015). Chaalal et al. (2023) and Willems (2021), stated in their articles, as well as Ling who also suggests that autonomous transportation presents a similarly related set of issues. Some discussions focus on human transport operators—such as driverless car testers or truck dispatchers—who remotely monitor and occasionally intervene in the operations of autonomous vehicles.

II. SECURITY RISKS POSED BY AUTONOMOUS WEAPONS

Moreover, according to Falco et al. (2021), human beings are limited in the number of continuous activities they can monitor and control, and this limitation hinders oversight and control measures intended to mitigate accidents. AI designed for military governance may function until interrupted by human intervention, which could lead to human-aware AI inadvertently or accidentally initiating conflict by misapplying force or escalating situations prematurely. Each of these characteristics of AI development can foster AI escalatory dynamics that increase the likelihood of accidental engagements and ongoing conflict. In this context, the decision-making capabilities and reflexivity of AI pose a security threat across a range of conventional and unconventional tasks (Dobbe, Gilbert & Mintz, 2021; Manning et al., 2023; Pöhler et al., 2024; Yeboah, Opoku-Mensah & Abilimi, 2013b). Additionally, since many of these engagements and policies are deniable, it is likely that framers will utilize them instead of compellence functions to test the resolve and capabilities of foreign actors without having to accept responsibility for escalation up to nuclear conflict. As autonomous weapons continue to develop and become more widespread, they are likely to lead to more extensive and destructive conflicts, as well as potentially accidental confrontations (Abaimov & Martellini, 2020; De Ágreda, 2020; Abilimi, Sarpong Adu-Manu, Addo, 2013; Hendrycks et al., 2023). First, autonomous weapons could be engineered to target assets more adeptly than any human, either due to a lack of moral or physiological constraints or superior processing capabilities. Consequently, these weapons could excel in kinetic functions as well as in blockading, disruption, espionage, and other forms of non-kinetic activity in a highly competitive environment. As a result, other agents may feel compelled to escalate their actions, leading to a security dilemma.

2.1. Potential Misuse and Ethical Concerns

From an internal perspective, the emergence of AI-powered autonomous weapons and their potential misuse as instruments of violence present urgent ethical dilemmas (Batabyal, 2024; Ibrahim & Shuja, 2024; Whittlestone & Clarke, 2022). The

utilization of civilian technology for military purposes is not a new occurrence. In contemporary policy discussions, there is often a distinction made between civilian and military AI development. However, these boundaries are becoming increasingly blurred due to the nature of dual-use technologies. Some progressive nations have begun to implement regulations and ethical guidelines for the use of AI in dual-use contexts. Based on these principles, certain states, particularly in the West, differentiate between AI technology development for legitimate civilian applications and those intended for military use (Abilimi, Addo & Opoku-Mensah, 2013). These strategies, however, fall short due to a lack of clear differentiation between civilian and dual-use sectors, and they overlook the reality that the current global geopolitical landscape shows that both state and non-state actors engage in illegal warfare. The swift advancement of AI-powered autonomous weapons may lead to imbalanced power dynamics among actors (Hynek & Solovyeva, 2021; Toscano, 2022; Fioravanti, 2024). For instance, a nation investing in AI-driven military technology can more readily exploit an adversary's vulnerabilities, thereby increasing the likelihood of state-sponsored violence. The era of information and communication technologies in military affairs has introduced significant challenges to peaceful conflict resolution. The current context of international power politics and security policy suggests a considerable risk that nations will perceive themselves as more secure if they possess AI-powered autonomous weapon systems. From a structural perspective, this results in negative security implications.

III. UNINTENDED ESCALATION OF CONFLICTS

For instance, in a conflict between two rival powers, a malfunctioning AI-controlled drone could mistakenly launch a missile, while hackers might target these drones and subsequently take control of them for their home country (Galdorisi & Tangredi, 2024; González Peralta, 2022). An unknown organization, nation, or terrorist group could aim at the systems of both adversaries to instigate and potentially win a Third World War. All these scenarios lead to the same conclusion: in a world with lethal autonomous weapon systems (LAWS), crisis stability may deteriorate (Favaro, Renic & Kühn, 2022; Williams, 2021). Furthermore, in similar local conflicts, combined with information asymmetry and aggressive behavior, worst-case scenarios such as disarmament could arise and escalate into regional infernos. Consequently, the unpredictability of AI-powered escalation and the uncertainty of when and where it can cease or de-escalate should be significant factors in decision-making (Marcano et al., 2020; Tengilimoglu, Carsten & Wadud, 2023; Feldman et al., 2019; Gilbert & Gilbert, 2024g).

According to Whittlestone and Clarke (2022), Batabyal (2024), Ibrahim and Shuja (2024), the integration of AI technologies into the decision-making processes of autonomous weapons likely introduces previously unexplored escalation threats. The input/output processes of AI complicate human understanding, control, and assessment of the consequences of decisions made by AI. Generally, AI lacks the ability to anticipate or adhere to logical orders or moral considerations, which can lead to unexpected negative

outcomes (Tóth, 2022; Huang et al., 2022; Gilbert & Gilbert, 2024k). Particularly, the more effectively AI models human behavior, the more efficient and successful it becomes, but it also increasingly develops human-like biases, potentially targeting specific populations, genders, or cultures.

3.1. Case Studies and Historical Examples

The advancement of Autonomous Weapons Systems (AWS) presents new ethical, legal, and moral challenges (Mhlanga, 2023; BOUEY et al., 2023; Ciuriak & Rodionova, 2020; Taddeo & Blanchard, 2022; Wood, 2023). The paradigm shift that has transitioned targeting responsibilities from humans to machines opens up numerous unforeseen circumstances regarding changes in military strategies and tactics, the rethinking of intelligence and weapon technologies, and even human evolution (Jensen, Whyte & Cuomo, 2022; Gilli et al., 2022). While there is widespread consensus within military circles regarding the ethical and legal issues, this does not imply that the research and development of AWS by nations has ceased. The development of AWS raises significant ethical and legal questions for international military law (IHL), and addressing these concerns is urgent and complex, requiring a diverse range of expertise in law, engineering, computer science, ethics, and bioethics (Lucas, 2022; Amoroso & Tamburrini, 2021; Jacobsen & Liebetau, 2023; von Struensee, 2021; Fallocco, 2019). The choice to deploy an AWS is a moral decision, and the AI systems employed must be designed to ensure the highest possible security for both military personnel and civilian populations.

AWS can vary in complexity, ranging from systems capable of accurately identifying and engaging enemies in a short time frame to fully autonomous spacecraft capable of executing multiple missions independently, utilizing a central AI or multiple AIs performing different functions, contributing to an arms race to develop innovative weapons with artificial intelligence (Wu, 2022; Abaimov & Martellini, 2020; Schwarz, 2021; Brundage et al., 2018; Gilbert & Gilbert, 2024j). This discussion will focus on the development of autonomous military robots that can select their own targets and engage them with lethal force without human intervention during the selection and operational phases. The first category involves adaptive systems that can flexibly modify their behavior to enhance performance when environmental or internal conditions change, similar to how rooster or rabbit farms can adjust their feeding systems. The incorporation of artificial intelligence (AI) into the defense sector is not a recent development, but the increasing militarization of AI calls for an international treaty and norms to ensure genuine control over the use of AI-powered weapons (Hynek & Solovyeva, 2022; Roy, 2024; Rashid et al., 2023; Wilk, 2019). Although International Humanitarian Law (IHL) exists to regulate the design and production of weapons, the growing role of AI in these systems challenges the definitions and interpretations of IHL principles. The primary concern regarding AWS is their potential for unrestricted strike capabilities and the resulting unintended consequences (Granzotto, 2021; Simmons-Edler et al., 2024; Gilbert, Oluwatosin & Gilbert, 2024). These systems could lead to escalated conflicts and geopolitical instability,

which in turn may adversely affect AI research and application, creating a dilemma between further militarization and disadvantages in AI research and application within the international community.

IV. CURRENT STATE OF DEVELOPMENT AND DEPLOYMENT

The Global Artificial Intelligence Index indicates that the United States is at the forefront of AI capabilities worldwide, closely followed by China (Hine & Floridi, 2024; Bal & Gill, 2020; Horowitz et al., 2022). Together, these two nations account for 84 percent of global AI authors, nearly 75 percent of the total number of patents, and over 60 percent of the current pool of top-tier AI professionals. Iran's pursuit of AI and AI-enabled autonomous weapons is motivated by its military strategy to counter both conventional and nuclear threats (Dobbe, Gilbert & Mintz, 2021; Manning et al., 2023; Pöhler et al., 2024). Russia has extensively employed autonomous systems in conflicts in Ukraine and Syria. The Kronshtadt Group, a Russian arms manufacturer, has announced plans to showcase its latest Orion-E strike drone at the MAKS 2021 air show. Additionally, the Russian "Peresvet" laser system, a fully automated ground-based combat system, operates on AI (Bērziņš, 2020; Hoffmann, 2022). North Korea is also believed to be developing drones and utilizing AI to address broader military challenges. The Hwasongpho project, led by Pyongyang's Korea Development Institute (also known as Punggye-ri), is assisting North Korea in pursuing military advancements centered around AI-driven space technology (Rashid et al., 2023; Lee, 2021). Currently, 32 countries have been confirmed to be developing autonomous weapons systems, with certain nations' investments in military AI seemingly extending to autonomous weaponry (Longpre, Storm & Shah, 2022; Kvasňovský, 2020).

Both developed and developing nations are demonstrating a militaristic drive toward autonomous weapons. These countries are expanding relevant research and development, conducting military tests of various technical prototypes, and integrating AI and robotics into their military organizational structures (Marcano et al., 2020; Tengilmoglu, Carsten & Wadud, 2023; Feldman et al., 2019). In June 2019, China established the world's first government agency dedicated to the development and deployment of AI and surveillance technologies for public security and military applications, known as the National Laboratory for Intelligent and Autonomous Systems (ILA) (Walsh et al., 2021; Zhao, 2019). China has been incorporating AI and machine learning into peacekeeping operations, which are also expected to have significant military applications. The country has shown interest in the potential uses of swarm robotics in (semi-)autonomous weapon systems, such as UAVs, USVs, and UUVs. The European Union is investing over €2.6 billion through the European Defence Fund to develop cutting-edge technologies focused on military applications (KAMARAS, 2023; Dominese, 2020). The largest single project within this program, the Eurodrone, has an estimated cost of €8 billion.

4.1. Technological Advancements and Capabilities

Non-state actors, such as insurgents and terrorists, often lack fixed geographic locations or organized military structures, which may allow them to appear unified under religious or tribal affiliations to the states in which they operate (Tankel, 2019; Ludvík, 2023). This situation could exempt them from directly violating the United Nations Charter Chapter VII “Act of War” when accused of Crimes Against Humanity and/or War Crimes in the International Criminal Court (ICC) (Endoh, 2020). Given the legality surrounding self-defense against an imagined enemy, non-state groups could operate under the guise of state sovereignty while targeting civilians (Granzotto, 2021; Simmons-Edler et al., 2024).

To effectively regulate autonomous weapons, a shared understanding of their successes and failures is essential. This regulation should prioritize the protection of human rights and international humanitarian law, avoid pitfalls associated with anthropogenic artificial intelligence (AI), and uphold the United Nations Charter Chapter VII “Act of War” (Khan, 2023; Garon, 2022; Mignot-Mahdavi, 2023). Furthermore, the integration of AI must be guided by ethical principles while also fostering the AI economy. Regulation should focus on controlling weapons and cyberspaces while continuously monitoring the evolving technical and legal landscapes (Lee, 2022; Peng, Lin & Streinz, 2021; Azer & Samir, 2024).

V. EXISTING INTERNATIONAL LEGAL FRAMEWORKS

The concept of Autonomous Weapons Systems (AWS) is rooted in an aerospace power approach that originated from

anti-aircraft defense applications (Kwik, 2022; Drake, 2021). The weapons developed within this framework are significant targets due to their potential to be utilized against adversaries' equipment and assets (Johnson, 2019). The deployment of AI-based AWS technologies in military operations raises concerns regarding technology reliability, decision-making predictability, ethics, and social acceptance. The combined effects of the battle environment are realized through the integration of conventional weapon systems, electronic warfare assets, unmanned systems (UXVs), and their data networking with reference to combat operations in the forms of electromagnetic, thermodynamic, and positional and range capabilities (O’Hanlon, 2018; Coors, 2022). To generalize, the proposed military missions supported by the combination of AI and AWS are defined in strategic operational terms as follows: Surveillance, Intelligence, Reconnaissance (SIR), and Fire Support (FT); these are broad assignments. The geographic elements in the doctrinal construct of AI-based AWS have two fundamental dimensions. First, the geopolitical dimension: the success and support of legal and ethical alignment and its impact on global stability and trust in the international AI and machine learning race, in line with the overarching goal of maintaining a well-equipped program in the designated zones (Mhlanga, 2023; BOUEY et al., 2023; Ciuriak & Rodionova, 2020; Taddeo & Blanchard, 2022).

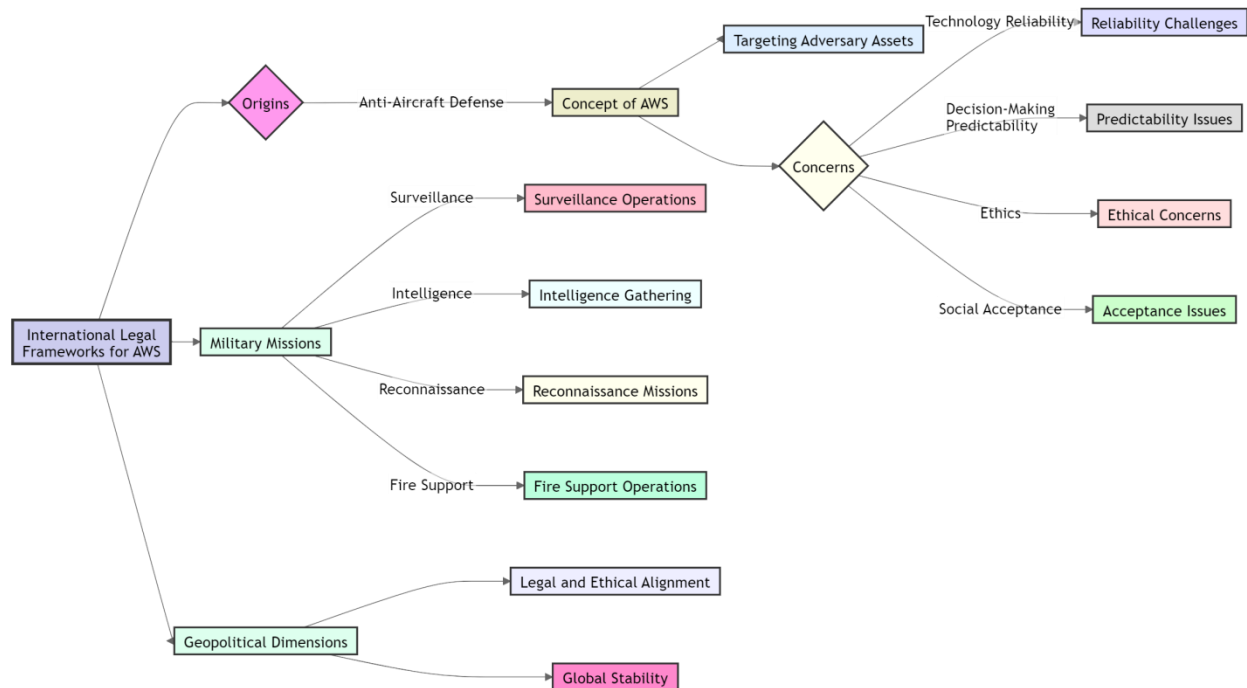


Figure 2: Existing International Legal Frameworks of AWS

The geographic region where AI-based autonomous weapon systems will be deployed is influenced by several objectives, operational environments, and specific combat missions. Today’s AI-based autonomous weapon systems

(AWS) are involved in inspections, surveillance, stratification, and intelligence analysis. In this context, the regional geographic terrain is a crucial aspect of geographical intelligence (GEOINT) in military operations. The calculation

of GEOINT is conducted across all regional and geographic areas where the use of autonomous weapons systems is defined. The geographic region designated for AWS deployment emerges as a competitive area in military operations, as it intersects with multiple military objectives. It serves as the foundation for all military operations, from reconnaissance activities to long-term combat operations (Granzotto, 2021; Simmons-Edler et al., 2024). See *Figure 2* above.

5.1. Geneva Conventions and Laws of War

With the introduction of new weapons, regulatory measures are necessary to prevent harm to innocents, even though military personnel are not solely responsible for the death and destruction as defined by official rules. Autonomous Weapon Systems (AWS) currently lack these regulations and are primarily intended for engagement with combatants (Wood, 2023; Rantanen, 2024). However, through accidental or uncertain events, civilians and innocent individuals often find themselves caught in conflicts, leading to significant harm and disruption to their lives, which attempts to circumvent non-combatants. The role of AI is critical here, as it contributes to the violation of essential rules, understandings, and selective weapon systems by incorporating International Humanitarian Law (IHL), which can help protect human life from massive destruction (Garcia, 2019; Klonowska, 2022; Acquaviva, 2022). Furthermore, a governance structure is necessary for these systems, as they are unable to deliver accurate technical efficiency due to the challenges in evaluating the outcomes of these potentially harmful systems. The number of architectural frameworks that are genuinely effective would be immeasurable if the decisions made by these AWS were judged solely on their technical success. For these reasons, numerous global organizations, non-governmental entities, and countries advocate for the establishment of a comprehensive, binding norm on AWS (Hynek & Solovyeva, 2021; Toscano, 2022; Fioravanti, 2024).

The rise of military autonomous weapons systems has become a growing area of concern in recent years for several reasons. On one hand, there is speculation about the strategic advantages that autonomous weapons could potentially provide. On the other hand, there are concerns regarding the ease with which algorithms make decisions, the possibility of adversaries developing effective countermeasures to undermine autonomous weapon systems, and the rise of opportunistic warfare (Gilbert & Gilbert, 2024e; Mhlanga, 2023; BOUEY et al., 2023; Ciuriak & Rodionova, 2020; Taddeo & Blanchard, 2022; Yeboah, Odabi & Abilimi Odabi, 2016). Rushing to create a policy framework for this technology is inherently risky, as it could hinder potential advancements or help realize the full capabilities of autonomous systems. It is widely recognized that regardless of the objectives of AI programs, there is an urgent need to explore the legal and ethical implications to give global governments sufficient time to develop appropriate policy instruments before it is too late. This issue is currently a matter of justified concern for ethical and legal reasons, while various modalities of aggression and conflict are anticipated (Hynek & Solovyeva, 2021; Jafariandehkordi, 2024; Dresp-Langley, 2023).

VI. CHALLENGES IN REGULATING AUTONOMOUS WEAPONS

According to Granzotto (2021) and Simmons-Edler et al. (2024), the further development of regulatory efforts by state actors to prevent both qualitative and quantitative escalation of autonomous weapons systems presents various advantages. However, significant challenges exist in establishing a regulatory framework that is genuinely comprehensive, both in terms of subject matter and geographical scope. On one hand, it must account for the innovation and technology cycles that govern the development and deployment of autonomous systems, while on the other hand, it should consider the diverse geopolitical contexts that influence arms control dynamics. With the anticipation of an arms race and the expected continued negative impact of AWS on global peace and security, the stakes for effectively addressing the rapid development and potential misuse of AWS in armed conflict are higher than ever. According to Hynek and Solovyeva (2021), Jafariandehkordi (2024), and Dresp-Langley (2023), the multilateral group of governmental experts (GGE) on Lethal Autonomous Weapons Systems has made valuable progress in recent years through its three previous sessions, aggregating states' positions on legal issues and developing further norms regarding safety and the role of human control. Nevertheless, the GGE has produced only limited resolutions aimed at bridging gaps in legal and ethical norms, and these resolutions are non-binding, which hampers the overall process. National regulations have also tightened, particularly concerning AI, in response to increased competition in AI development and concerns about its implications (Smuha, 2021; Smuha, 2021). However, this tightening has primarily focused on AI for strictly civilian applications. The intersections of autonomy, lethality, and the existing capacity for autonomous decision-making in civil security infrastructure and warfare—whether kinetic or non-kinetic—represent significant points of convergence that prompt the policy community to not only regulate their harmonization in security-relevant applications but also to consider various ethical and human rights implications (Jafariandehkordi, 2024; Warren & Hillas, 2023; Christie et al., 2024; Opoku-Mensah, Abilimi & Amoako, 2013).

6.1. Technological Complexity and Rapid Advancements

Governments could leverage AI capabilities to develop and maintain their military and legal systems while effectively managing large global infrastructures without increasing the number of human personnel, thereby ensuring global peace and security in a more structured, effective, and efficient manner (Horowitz & Kahn, 2024; Brandusescu, 2021; Alami et al., 2021). While the use of AI presents expected positive developments, military and legal professionals must be prepared to address new and unforeseen challenges related to the performance and effectiveness of autonomous systems, as well as individual methodologies or even class, type, and category features at the levels of infrastructure, command-control-telecommunications intelligence, and operations (C2I2), production, financial management, and strategic doctrines (Bean & Melzer, 2021; Firlej & Taeihagh, 2020). Additionally, they should focus not only on awarded inventions

but also on patents or patent applications related to pending or proposed adversities. To be optimally prepared for any negative scenarios, groups related to AI, LAWS, and AS must be systematically and regularly established, and opportunities must be sought to overcome organizational barriers on a global scale, which is a significant responsibility for all pioneers of international and bilateral agreements.

The complexities of artificial intelligence (AI) technologies are expected to grow increasingly intricate, occupying a substantial portion of both military and commercial technology advancements in the foreseeable future. AI, as a general-purpose technology, possesses features that could provide solutions to current and widely recognized issues involving both military systems and law enforcement (Lee, 2022; Vöney & Schmidt, 2024; King et al., 2019). However, these same characteristics could also equip criminals with the tools necessary to commit acts of violence and terror more efficiently in the future. First, AI technologies offer functionality and flexibility—particularly concerning control over the decision-making process—that are extremely challenging to define and regulate when embedded in weapon systems (Marcano et al., 2020; Tengilimoglu, Carsten & Wadud, 2023; Feldman et al., 2019). Furthermore, the international proliferation of these technologies and the resulting open-source approach also carry security implications. It is undeniable that countermeasures capable of addressing these potentially dangerous applications and attempts will also be developed, similar to the aforementioned open-source approach.

VII. ETHICAL CONSIDERATIONS AND MORAL DILEMMAS

This proposition highlights that ethical concerns, including moral dilemmas, are significant when discussing AWS. They warn against reprogramming smart weapons with “Kantian ethics.” The paper concludes by arguing that ethical considerations related to AI and autonomous weapons systems suggest a contradictory reprogramming of military tools: “artificial intelligence in warfare, threatened by regulatory twilight, might not only destabilize international relations and contribute to strategic antagonisms between leading global powers, but also pose the risk of an unprecedented moral hazard of global magnitude” (Johnson, 2022; Bartneck et al., 2021; Metcalf, 2022). Addressing the moral challenges posed by AI in warfare and the corresponding legal norms may present a crucial opportunity to redefine the aims, purposes, and practices of military research and development in a democratic and ethically acceptable manner.

Reprogramming weapons with AI technologies may challenge existing legal frameworks for warfare, states, and intergovernmental organizations (Longpre et al., 2022; Abaimov & Martellini, 2020; Hynek & Solovyeva, 2021; Jafariandehkordi, 2024; Lewis et al., 2016). The primary obstacles to advancing regulation into reality are definitional debates, which complicate issues of responsibility and accountability. Establishing norms through diplomatic or self-regulatory means remains an alternative. However, emphasizing the ethical dimensions of AI developments can provide a stronger argument for governing technology, thereby focusing on preventing the moral hazards of war rather than its

legal consequences. As Bonacker, Ludewig and von Unverzagt (2018) argue, “ethics should guide military technological development, rather than law consistently following technology.”

7.1. *Autonomy and Accountability*

In our view, it is sensible to develop general principles and guidelines regarding the appropriate uses of AI. These principles could delineate the line between utility-maximizing prudence and ethics-oriented conceptions of AI technologies. Not all advancements in AI should be pursued; as previously stated, ethics are at least as important as capability. Simultaneously, we should not allow other nations to advance in areas where we could fall behind, leading to a hegemony of AI and strategic influence. Therefore, we must focus on disentangling military and commercial issues. The more aware professional AI developers are of this problem, the better we can manage it. However, framing everything as ‘AI is an ethical problem’ does not provide much assistance (Granzotto, 2021; Simmons-Edler et al., 2024).

According to Hynek and Solovyeva (2021), Toscano (2022) and Fioravanti (2024), if autonomy is not achieved uniformly, AI-enabled technology stacks will diverge across markets such as military and commercial applications. When developing an AI or software stack, the components are not labeled: this is software for a phone, this is software for a military weapon system. When best practices are established in one field, they may be adopted by others (Hynek & Solovyeva, 2022; Roy, 2024; Rashid et al., 2023; Wilk, 2019). We need entirely new techniques and strategies to address this issue because if I create an algorithm and then provide it to a company that transforms it into a mobile application and another company that converts it into a weapon platform, we encounter an ethical dilemma since I lose control over where the technology is applied. This is not just a future concern; it is happening now with many technologies. There is a direct line of conversion between what is being developed in academic research and what the military is acquiring, and there seems to be a lack of concern about this. We need new techniques, norms, and approaches to prevent this from occurring.

VIII. POLICY RECOMMENDATIONS FOR INTERNATIONAL REGULATION

This chapter outlines an agenda for international regulation: 1) The adoption of international policies to slow the proliferation of AI to autonomous weapons development facilities; 2) The formation of an international scientific and technical board for AI; 3) The establishment of a new regime of strategic constraints, encompassing multiple technologies that underpin offensive LAWS (Leung, 2019; Feijóo et al., 2020). Attracting the broadest possible participation, signature, and adherence rates to such treaties, akin to nuclear-freeze agreements, enhances their value in promoting international stability and confidence. To create the scientific and technical board, countries might collaborate within a specific multinational framework of regular meetings among the national academies of the three original nuclear freeze proposers: the United States, the United Kingdom, and the

Union of Soviet Socialist Republics (USSR), along with supportive countries that are members or associate members of the academies of science of these nations. This board could make informed recommendations regarding the broad framework of responsible, ethical, and accountable development, deployment, and use of AI systems across diverse applications and technological contexts.

Artificial intelligence (AI) is central to competition policy and national security policy, and it will drive economic productivity and job growth on a global scale (Ali Khowaja et al., 2023). However, it also presents significant risks across the various technologies and applications where it will be deployed. One combat technology—offensive lethal autonomous weapons (LAWS), sometimes referred to as “killer robots” or “synchronized operations based on velocity assessments”—poses particularly troubling challenges for international security. If numerous vulnerabilities are exploited in a series of enticing advancements, multiple generations of offensive LAWS could evolve and proliferate within the next few decades (Littman et al., 2022). This study argues that a renewed discussion on how to better govern AI in relation to LAWS is critically needed.

8.1. Establishment of Clear Definitions and Classification

A significant milestone in the realm of human law is the Laws of Armed Conflict (LOAC), commonly referred to as the “Geneva and Hague Conventions,” which date back to 1868. Although the LOAC addresses both the use of Lethal Autonomous Weapons (LAWS) and the principle of distinguishing between civilians and combatants from other legal targets, the term “LAWS” was informally introduced in 1977. This occurred when an amendment known as the “First Additional Protocol” was adopted by the contracting nations of the original Conventions, effectively establishing a de facto conditional ban. The term Autonomous Weapon System (AWS), which we prefer to use as a broad umbrella term, not only encompasses Lethal Continuous Deployment (LCD) but also must support the confirmed potential for applicable behavior control. This raises the risk of such systems autonomously selecting their preferred targets and determining the actions they wish (or are capable) to undertake, as well as establishing a command chain between the target and the launch location or deployment medium.

It may be wise to initiate the regulation of military AI with a straightforward yet enduring concept: “clear definitions, classification, and taxonomy” (Leung, 2019; Feijóo et al., 2020). The formulation of policies and regulations relies on understanding the capabilities of various AI-autonomy systems, the potential consequences they pose, and when a system is inherently “autonomous.” Although these are abstract concepts, official and legally binding registries could include clearly defined taxonomies. Furthermore, standards and guidelines would delineate such terms according to operational levels of autonomy, along with similar planned determinations in robotics (Brundage et al., 2020). As a first standardized definition of an Autonomous Weapon System (AWS), it would be appropriate to align with the currently accepted terminology of “Lethal Autonomous Weapons” (LAWS). LAWS represent a

subclass embedded within the broader category of End-to-End Autonomous Weapon Systems (EE-AWS) (Granzotto, 2021; Simmons-Edler et al., 2024).

IX. CREATION OF MONITORING AND COMPLIANCE MECHANISMS

On the military front, the integration of AI into weapon systems is a continuation of a trend toward military automation that may ultimately lead to the implementation of LAWS. However, this gradual transition from human roles in weapons systems to fully autonomous AI systems could bring about significant changes in military operations in the future. One challenge is defining what constitutes an autonomous system and determining when it becomes morally, legally, and security-wise problematic for such systems to be equipped with AI and to make lethal decisions independently (Moital, 2024; Georginova, 2023; Vecellio Segate, 2022; Gupta et al., 2022). Due to these characteristics, LAWS can produce destabilizing effects, fuel arms races, increase transparency issues, and create trust divides, posing significant challenges in terms of AI governance, especially if they are adopted before an adequate regulatory framework is established. For all these reasons, many experts are advocating for prompt and decisive action to control LAWS and their usage (Bareis & Katzenbach, 2022; Re & Solow-Niederman, 2019). This issue is not merely technological or operational; it is vast and multifaceted, with implications for humanitarian law, human rights, peace and security, arms control, ethics, accountability, and more.

The development and deployment of LAWS (lethal autonomous weapon systems) raise numerous issues concerning international security, many of which directly involve the implications of AI (artificial intelligence) technologies in military and security contexts. Areas of concern include unpredictability and lack of control in autonomous decision-making, the difficulty of attributing actions taken by LAWS, and the potential consequences of the highly desirable defensive capabilities of AI technologies. LAWS risk undermining existing deterrence understandings and complicating the maintenance of global security due to their ability to engage autonomously in ambiguous, high-speed, and escalation-prone situations during military confrontations (Leung, 2019; Feijóo et al., 2020).

9.1. International Oversight Bodies

Interest in AI ethics within the US Department of Defense and its closest allies has surged in recent years, largely driven by experiences with AI deployments in counterterrorism operations conducted by American armed forces. However, two principal processes have emerged, which are complementary yet distinct in terms of participants. The first focuses on the rapid creation and deployment of AI technology, with China and Russia collaborating closely in this area (Tuzov & Lin, 2024; Kendall-Taylor & Shullman, 2021). The second is centered on new technologies that energize international relations, exacerbating conflicts and arms races. This aspect highlights the significant dangers associated with the development of military AI technology, particularly fully autonomous systems (Hynek & Solovyeva, 2021;

Jafariandehkordi, 2024; Dresp-Langley, 2023). Delaying action for further evaluation can lead to dangerous mistakes, the consequences of which may not be evident for years. This principle draws on the historical context of the nuclear arms race and has garnered the attention of the international community. The nuclear regulatory system does not diminish or halt the accumulation of new generations of nuclear weapons, nor does it prevent the ongoing modernization of smaller nuclear states; however, it functions effectively. Maintaining corporate influence in this challenging dialogue at the UN forum regarding regulatory capabilities will contribute to international peace and security. Formulating and adopting relevant regulations, along with demonstrating that leading technology corporations prioritize human life over profit, are essential steps.

Examples illustrate the dangers of deploying AI in various ways, with differing degrees of autonomy and lethality (Leung, 2019; Feijóo et al., 2020). For instance, simple armed drones contrast sharply with fully autonomous smart weapons. Additionally, the potential for AI deployment is widely discussed in the context of specific technologies like swarming drones, which are already shaping new generations of national conceptual documents. The formal regulatory process began in 2017 with a UN decision to establish a group of governmental experts (GGE), followed by the creation of an open-ended working group (OEWG) in 2019 to address these issues (Paulus, 2024; Douzet, Géry & Delerue, 2022). Both forums involve a broad spectrum of member countries and various stakeholders, including humanitarian organizations and subject matter experts. While the process does not have a fixed timeline, the agendas of UN conferences—primarily focused on new technologies and their implications—provide some direction for the work of the Geneva group.

X. LIMITATIONS AND CHALLENGES OF POLICY IMPLEMENTATION

The ongoing debate surrounding human copycat crimes and capital punishment raises important questions about the implementation of regulations governing AI to prevent the worst-case scenarios of AI-regulated warfare. In combating international terrorism, the EU engages in regular policy dialogues and joint initiatives aimed at compelling national actors to eliminate illegal content, which is intended to disrupt or apprehend criminals by uncovering their true identities, particularly targeting terrorist offenders (Andreeva, 2020; De Londras, 2019). This approach highlights the significance of AI in digital law enforcement. According to the authors, AI and autonomous systems will fundamentally drive the U.S. to initiate and promote migration, surveillance, and military applications of these technologies. The need to balance against the AI capabilities of Russia and China will also push the U.S. toward AI dominance, as deterring these nations is seen as essential (Schmidt, 2022; Fricke, 2020; Johnson, 2021; Jang et al., 2022). However, these efforts to gain an advantage in AI may not only lead to ethically responsible applications but also to directly unethical uses, such as autonomous weapons and large-scale human rights violations (Leung, 2019; Feijóo et al., 2020). The implementation of policies within a country can

vary based on numerous factors. However, the effectiveness of policy implementation in the international arena concerning unfortunate autonomous weapons regulated by AI is equally crucial. While China and the United States have revealed their approaches and willingness to regulate AI, certain media developments may hinder AI regulation. Reports indicate that the Chinese government is utilizing AI to monitor and oppress Uighur Muslims, raising concerns about whether Western nations can trust China in broader contexts related to defense against AI-regulated warfare. This situation suggests that, beyond the national autonomy required for warfare, international regulation could also help maintain geopolitical power relations. Current geopolitical power hierarchies and dependencies will significantly influence the extent to which successful AI regulation is implemented (Oliveira, 2024; Taylor, 2024; Ala-Pietilä & Smuha, 2021; Goh & Vinuesa, 2021). Other ongoing projects and principles are also shaping global patterns in the operationalization of AI. In the current balance of power regarding AI applications, criteria will be vital for AI developers, policymakers, and civil society, as AI implementation negotiations contribute to power hierarchies among governments and nations.

10.1. Enforcement and Verification

One limitation in verifying many AI-related issues is that the data involved is high-dimensional and not easily interpretable. Evaluating the stability and performance of machine learning or deep learning systems, which leads to interpreting results, remains an open area of research. The use of verification and validation of AI through governance codes, along with transparency in the models employed, means that companies should be held accountable for adhering to security and ethical obligations (Díaz-Rodríguez et al., 2023; Mylre & Robinson, 2023; Roberts et al., 2021). The IMM approach aims to address this by employing language model compression to constrain an AI system to utilize only safe policies, ensuring proofs of safety characteristics. This formalization is necessary in an industry landscape filled with opinions, anecdotes, and unfounded rhetoric. The success of safety laws and ethical guidelines hinges on effective enforcement and the ability to verify compliance. New agencies or modifications to existing ones may be required to enhance enforcement effectiveness. Methods such as facility inspections, documentation reviews, performance evaluations, periodic recertifications, and unannounced inspections can be employed to verify compliance (Oliveira, 2024; Taylor, 2024; Ala-Pietilä & Smuha, 2021; Goh & Vinuesa, 2021). Developing verification protocols that are not overly intrusive to research and development while still achieving verification objectives will be an important area of research. Some organizations are formulating plans for the verification of electronic surveillance, as described in “Alien Minds.” The measures outlined in that chapter include analyzing firmware and device components, monitoring sources and flows of electronic signals, and utilizing open-source intelligence. Detecting compliance failures is also crucial, and information regarding such failures can be sourced from the general public.

XI. POTENTIAL BENEFITS OF AI-POWERED AUTONOMOUS WEAPONS

AI-powered battlefield technologies have the potential to be either devastating or pacifying in both civil and military applications. Experiments aimed at detecting AI applications in sociogenesis, where AI controls its underlying individuals within civil society, have not gone as planned. A maxim-informalist stigmatization of these AI systems may find fault with their designers; such an aberration is defensible when AI is programmed to evaluate AI, as it stands equal on the uninformedness scale with uninformed devices. The localization of benevolent marksmen could eliminate all advantages that AI judgment provides to remote marksmen. Action can then unfold fearlessly in a straightforward arena of immediate consequence, revealing the AI judgment's benevolence toward social good (Leijia, 2017). Requirements for minimizing the destructive impact of military measures range from potential criminal sanctions to the failure of military gloss, aiming for maximal social good within the framework of social institutions.

(Zajac, 2023; Feldman et al., 2024) The potential benefits of AI-powered autonomous weapons for warfighters include the ability to enable AI to divert, repurpose, or swarm munitions, as well as reprogramming them for innovative uses on the fly during conflict. This engineering finesse in the design of updates may be adaptable during warfare with a nation but may be less clear in chaotic and unmeasured settings involving non-state actors. Unmanned Autonomous Battlefield Protectors launching a disastrous war against a cyber-adversary from any country may utilize their emergent, ahead-of-schedule AI to defend themselves (Wu, 2022; Macagno, 2022). Being both AI-embedded and AI-initiated, minefields and preemptive strikes may be automatically executed and addressed in virtual adversities, with warfare retaliated globally in localized contexts.

11.1. Humanitarian and Peacekeeping Applications

According to Boston Dynamics, AI-powered robotic dogs, known as Spot or Big-Dog, are capable of delivering humanitarian aid to individuals in communities affected by epidemics and disasters, thanks to their precise navigation capabilities (Montanari, 2020). AI-enabled autonomous systems can conduct search and rescue operations quickly and efficiently. As a result, these systems are invaluable for rescue services following natural disasters or industrial accidents, as demonstrated by their use within the Indianapolis Fire Department in Indiana, USA. Escort robots facilitate the efficient delivery and navigation of autonomously operated rescue drone swarms, utilizing cameras and sensory aids to visually communicate with the rescue drones. The showcased rescue robot is employed by rescue services to prioritize public safety and enhance the effectiveness of search and rescue missions (Granzotto, 2021; Simmons-Edler et al., 2024). An autonomous system should be able to explain the rationale behind its actions or decisions, detailing where and how they were executed, the location of the operation, and whether ethical considerations were fundamental. Human and AI-

powered autonomous systems should work together effectively in ambiguous stabilization, reconstruction, and peace support operations.

According to Pauwels (2021) and Humble (2023), AI and autonomous weapons have the potential to significantly benefit humanity through applications in humanitarian aid and peacekeeping. AI-enabled autonomous systems can revolutionize humanitarian assistance and disaster relief operations. The use of autonomous vehicles in humanitarian logistics and disaster management offers unique advantages. For instance, the United Nations Office for the Coordination of Humanitarian Affairs (UNOCHA) prefers to utilize autonomous logistic systems to enhance rapid and cost-effective assistance to affected populations, particularly in conflict-affected regions. Autonomous vehicles can adapt their decision-making processes during the chaos of humanitarian logistics operations, especially in uncertain, dynamic, and unstructured environments. Furthermore, UNOCHA recognizes AI and autonomous systems as vital new tools, particularly for nighttime deliveries, circumventing road closures, and reducing human and mechanical stress during conflicts.

The diagram in **Figure 3** presents a proposed International Legal Framework for Autonomous Weapons Systems (AWS) with a systematic approach:

Initiate Framework: This serves as the foundation for creating the legal framework.

Define Scope: This step outlines the limits and focal points of the framework, categorized into three primary areas:

Military:

- Military Application: Concentrates on research and development efforts.
- Consider Ethics: Ensures that ethical considerations are incorporated into military applications.

Civilian:

- Civilian Use: Focuses on applications outside the military domain.
- Establish Guidelines: Develops specific protocols for civilian usage.

Commercial:

- Commercial Deployment: Relates to the business sector.
- Create Regulations: Formulates regulations governing commercial deployment.
- Review by Experts: Engages experts to evaluate the framework for strength and relevance.
- Ensure Compliance: Guarantees adherence to all guidelines and regulations across every sector.

Approval: The framework goes through a final approval stage to confirm its effectiveness and thoroughness.

Conclusion: This signifies the completion of the framework, making it ready for implementation.

The aim of this framework is to harmonize military, civilian, and commercial interests while ensuring ethical standards and regulatory compliance are upheld.

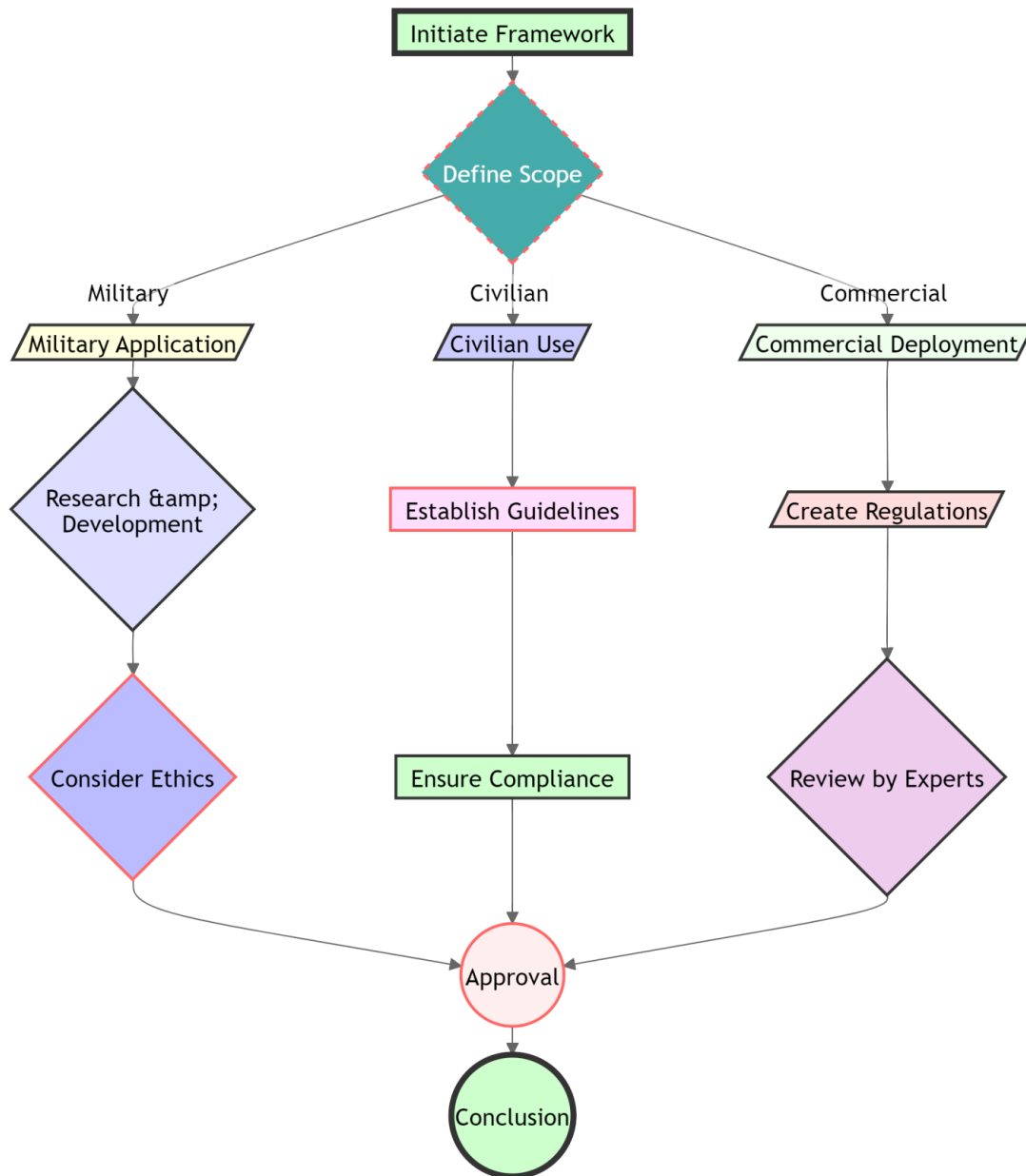


Figure 3: A proposed International Legal Framework of Autonomous Weapons System (AWS)

XII. CONCLUSION AND FUTURE DIRECTIONS

There should be a clear emphasis on human control (Granzotto, 2021; Simmons-Edler et al., 2024). It is essential to ensure that all decisions to engage a human target from a combat host are subject to effective, accountable, and human oversight. These decisions, whether made by the weapons themselves or by supporting military personnel, must always ensure that the potential harm is proportionate to the military advantage gained and complies with individual rights. Ultimately, the unique characteristics of these specific weapons should be addressed in new and deliberate international agreements. Comprehensive, cohesive, and effective governance is necessary to ensure that the guiding principles of the United Nations Charter, military considerations (both

offensive and defensive), stability, and the security of individual soldiers are upheld (Bakumenko, 2022; Mentan, 2020).

Strict limitations should be imposed on lethal autonomous weapon systems (LAWS) (Marcano et al., 2020; Tengilimoglu, Carsten & Wadud, 2023; Feldman et al., 2019). These restrictions should be incorporated into guidelines to assist countries in unveiling these advanced weapons, ensuring that they apply to both current and future technologies. This can be achieved by amending the scope of regulation within international humanitarian law (IHL) (Longpre et al., 2022; Abaimov & Martellini, 2020; Hynek & Solovyeva, 2021; Jafariandehkordi, 2024; Lewis et al., 2016). In this manner, even when these weapons are developed for non-offensive purposes, they will not wield excessive power in conflicts.

While it is likely that these amendments can be integrated under Article 36 of the 1977 Additional Protocol I and Article 48 of the 1949 Geneva Convention IV, specific provisions can also be made by referencing the 1972 Biological and Toxin Weapons Convention (BTWC) and the Ban on Anti-Personnel Mines (APM).

12.1. Summary of Key Findings

By examining various scholarly, military, and international security communities, it is possible to identify the potential of Autonomous Weapons Systems (AWS) to disrupt or influence (a) geopolitical stability, (b) notions of operational superiority, (c) pose an arms control dilemma, (d) drive a security dilemma, and (e) impact AI research and cooperation (Granzotto, 2021; Simmons-Eidler et al., 2024). Given the manipulation of AI-related research, development, and applications in society and economics, as well as to enhance international and national security, it is suggested that AI-related curricula evolve beyond the hype surrounding AI-powered systems and the classical theory and practice of AI. For instance, AI programmers or engineers should have a balanced educational curriculum that includes an interdisciplinary overview of ethics, society, law, human experience, and psychological factors. Additionally, a deep understanding of the history of AI in mechanized warfare and contemporary military orientation regarding the benefits and risks of AI will aid in better decision-making (Rashid et al., 2023; Gilbert & Gilbert, 2024h).

Autonomous weapons systems (AWS) represent a significant area of interest among scholars, policymakers, and the public. These systems differ from traditional weapons in that they can operate independently of human intervention, making decisions about targeting or attacking without human input. The primary questions surrounding AWS largely focus on ethical and legal principles, specifically regarding who should be held responsible for enforcing laws or violating norms. The prevailing view among scholars, policymakers, and practitioners appears to be that AWS will lead to indiscriminate outcomes and that they represent a solution in search of a problem (Zajac, 2023; Feldman et al., 2024). Beyond the divide between advocates and opponents of AWS, this account outlines the capabilities and vulnerabilities of AWS in terms of technomilitary considerations, treaty law, and norm formation regimes, within which AWS could be situated. It demonstrates that AWS may have several unintended impacts on the geopolitics and security landscape of AI.

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