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## ETHICAL BOUNDARIES OF AI-DRIVEN AUTONOMOUS WEAPONS

*The rapid development of artificial intelligence technologies and their active implementation in the military sphere are leading to multidimensional challenges encompassing ethical, legal, technological, and security aspects. Particular attention is drawn to the phenomenon of autonomous weapons, specifically combat systems capable of independently making decisions regarding the use of force without direct human involvement. Such an approach radically changes the understanding of the nature of modern armed conflicts, while at the same time generating risks of losing human control, violating international humanitarian law, and blurring the lines of legal and moral responsibility.*

*The relevance of this study lies in the need to develop clear mechanisms for the ethical and legal regulation of autonomous combat systems in conditions where international law has not yet established unified standards, and national legislation remains fragmented and unsystematic. The research hypothesis is based on the assumption that the absence of defined frameworks for the use of autonomous weapons creates the risk of uncontrolled use of force, the consequences of which could be catastrophic for both civilian populations and global stability and the international order.*

*The methodology includes an interdisciplinary approach that combines a comparative analysis of international legal acts, an assessment of ethical concepts of autonomous decision-making, a systematic risk analysis, and a critical discourse on the issue of civil and democratic control over military technologies. Particular attention is paid to the analysis of Ukrainian legislation and its compliance with international standards, taking into account the provisions of the Military Security Strategy of Ukraine.*

*The results of the study indicate that Ukraine's current regulatory framework only partially governs the field of autonomous weapons, while international*

## ЕТИЧНІ МЕЖІ ВИКОРИСТАННЯ АВТОНОМНОЇ ЗБРОЇ НА БАЗІ ШТУЧНОГО ІНТЕЛЕКТУ

*Стрімкий розвиток технологій штучного інтелекту та їх активне впровадження у військову сферу зумовлюють появу багатовимірних викликів, що охоплюють етичний, правовий, технологічний і безпековий аспекти. Особливу увагу привертає феномен автономної зброї, а саме бойових систем, які здатні самостійно ухвалювати рішення щодо застосування сили без безпосередньої участі людини. Такий підхід радикально змінює уявлення про характер сучасних збройних конфліктів, водночас породжуючи ризики втрати людського контролю, порушення міжнародного гуманітарного права та розмиття меж правової й моральної відповідальності.*

*Актуальність дослідження полягає в потребі формування чітких механізмів етико-правового регулювання автономних бойових систем в умовах, коли міжнародне право ще не виробило уніфікованих стандартів, а національні законодавства залишаються фрагментарними та несистемними. Гіпотеза дослідження ґрунтується на припущенні, що відсутність визначених рамок використання автономної зброї створює загрозу неконтрольованого застосування сили, наслідки якого можуть бути катастрофічними як для цивільного населення, так і для глобальної стабільності та міжнародного порядку.*

*Методологія включає міждисциплінарний підхід, що поєднує порівняльний аналіз міжнародних правових актів, оцінку етичних концепцій автономного ухвалення рішень, системний аналіз ризиків і критичний дискурс щодо проблеми цивільного та демократичного контролю над військовими технологіями. Окрему увагу приділено аналізу українського законодавства та його відповідності міжнародним стандартам, з урахуванням положень Стратегії воєнної безпеки України.*

*Результати дослідження засвідчують, що чинна нормативна база України лише частково регулює сферу автономної зброї, а міжнародні*

*conventions do not contain sufficiently specific provisions regarding fully autonomous systems. The need to develop ethical codes, ensure transparency of decision-making algorithms, create accountability mechanisms, and harmonise national legislation with modern international approaches is substantiated. It is emphasised that the integration of ethical and legal control mechanisms is a key condition for minimising potential threats, guaranteeing human rights, and ensuring global security in the context of a new military reality.*

*Keywords:* autonomous weapons, artificial intelligence, international humanitarian law, ethical standards, military technologies.

*конвенції не містять достатньо конкретних положень щодо повністю автономних систем. Обґрунтовано необхідність розробки етичних кодексів, забезпечення прозорості алгоритмів ухвалення рішень, створення механізмів підзвітності та гармонізації національного законодавства із сучасними міжнародними підходами. Підкреслено, що інтеграція етичних і правових механізмів контролю є ключовою умовою мінімізації потенційних загроз, гарантування прав людини та забезпечення глобальної безпеки в умовах нової воєнної реальності.*

*Ключові слова:* автономна зброя, штучний інтелект, міжнародне гуманітарне право, етичні стандарти, військові технології.

JEL Classification: K33, O33, H56.

## Introduction

Over the past decades, artificial intelligence has become a key driver of technological development, influencing the economy, security, international relations, and legal systems. Its application in the military sphere attracts particular attention, as it extends beyond mere technical innovation and raises fundamental ethical and legal questions related to global security and the humanity of armed conflict.

One of the most contentious areas is the use of autonomous weapons – systems capable of operating without direct human intervention. This approach alters the nature of armed operations while simultaneously raising a number of critically important questions: how to ensure oversight of decisions made by machines, who bears responsibility for their actions, and whether it is possible to integrate principles of international humanitarian law into algorithms incapable of moral judgment (Boulanin & Verbruggen, 2017).

Recent studies have initiated a debate regarding the legal and ethical boundaries of autonomous use of force. Specifically, human rights aspects of autonomous weapons have been examined (Heyns, 2016), technical ethics and risks of indiscriminate algorithmic actions have been analysed (Sharkey, 2010), the dehumanisation of decisions and moral dilemmas posed by autonomous systems have been explored (Asaro, 2012), and strategic and security risks have been assessed (Scharre, 2018).

Despite the significant contributions of these authors, issues of civilian oversight, allocation of responsibility, and adaptation of national legislation remain insufficiently studied, particularly in the context of armed conflicts.

The aim of this article is to reflect on the ethical boundaries of the use of autonomous weapons, analyse their role in contemporary warfare, and assess the need for international regulation. To achieve this aim, the following objectives have been identified: 1) to analyse international legal instruments concerning autonomous combat systems; 2) to evaluate ethical concepts related to autonomous decision-making; 3) to investigate the risks of losing human control; and 4) to compare national approaches to the regulation of autonomous weapons.

The research hypothesis posits that effective ethical and legal regulation of autonomous weapons is only possible through an integrated approach that combines international norms, national legislation, mechanisms of civilian oversight, algorithmic transparency, and humanitarian standards.

The information base of the study comprised international conventions, national regulatory acts of Ukraine, analytical reports from defence centres, scholarly publications, and materials from human rights organisations. Data processing was conducted through thematic classification, comparative analysis, systematisation of problematic aspects, and critical reflection on ethical models. The limitations of the study relate both to the empirical component (limited access to classified military protocols) and to the normative analysis (incomplete representation of internal state control procedures).

The main body of the article is structured in accordance with the logic of the research and encompasses five thematic sections. The first section analyses the ethical and legal issues of autonomous weapons, including challenges for international humanitarian law, questions of responsibility, and moral dilemmas associated with autonomous decision-making. The second section is devoted to risks to civilian oversight and international security, including the threat of losing human control over algorithms, the danger of misuse, and violations of humanitarian principles. The third section examines national practices for regulating autonomous weapon systems in Ukraine, with an emphasis on the regulatory and legal framework, participation in international initiatives, and dilemmas between defence needs and ethical obligations. The fourth section provides an analysis of global examples and corporate policies in the field of artificial intelligence, particularly the transformation of ethical principles by technology companies and their interaction with state structures. The fifth section proposes the integration of ethical and legal mechanisms in the use of autonomous combat systems, including the development of ethical codes, the implementation of transparency mechanisms, personal accountability, and humanitarian oversight.

This approach allows for a comprehensive exploration of the research problem, highlights its scientific novelty, and outlines practical avenues for its resolution.

## 1. Problem Statement

The development of next-generation autonomous weapon systems raises a number of complex issues that go far beyond technical efficiency. Whereas attention was previously focused on combat capabilities, there is now increasing debate over their moral and legal permissibility. Autonomous systems capable of operating without human involvement are already being integrated into military strategies, raising concerns about their impact on humanitarian law, ethical norms, and global security.

One of the key challenges concerns the issue of responsibility. If a decision to use force is made by a machine, it is unclear who should be held accountable: the state, the developer, the operator, or no one? Since algorithms are incapable of moral judgment, traditional approaches to legal responsibility lose clarity, creating a significant challenge for international law. Equally important is the issue of algorithmic transparency. Although algorithms give the impression of precision, decision-making mechanisms often remain opaque. In combat conditions, this may lead to erroneous strikes, the consequences of which are difficult to explain or analyse. Consequently, there is a need to establish control mechanisms that allow the actions of autonomous systems to be assessed in terms of legal and humanitarian norms. Particular attention should be given to the humanitarian application of such technologies. In peacekeeping missions, autonomous weapons can act quickly and impartially, yet without the capacity for empathy or moral evaluation of the situation. This calls into question their ability to distinguish between civilians and combatants, as well as to consider context, which is critically important for compliance with humanitarian law. Equally problematic is the determination of the boundary between permissible and impermissible use of force. Proponents of autonomous systems argue that they reduce human error, but critics emphasise that even the most advanced AI cannot take moral categories into account and, therefore, its decisions may conflict with humanitarian principles. The situation is further complicated by the absence of clear international norms regulating the use of fully autonomous weapons. This creates a legal vacuum in which states may experiment without adequate ethical accountability. Such a state of affairs could trigger a new arms race, in which the primary role is played not by human factors, but by the level of automation.

In view of this, the issue of autonomous weapons is not merely technical or military, but also civilizational. It raises the question of whether humanity is prepared to delegate the power over life and death to machines that lack consciousness, moral judgment, or the capacity for empathy. For this very reason, the development of ethical codes, international treaties, and standards is necessary, integrating technological progress with humanistic values and ensuring a balance between security and accountability.

## 2. Global Ethical Transformations in the Field of Military Applications of AI

At the beginning of 2025, the global technological community received a strong signal regarding the transformation of ethical guidelines in the development of artificial intelligence (AI). Google officially revised its ethical principles for the use of AI, which sparked active debates not only within academic and political circles but also among the wider public.

The very fact that the corporation revised its internal policy – which in 2018 had proclaimed restrictions on the use of artificial intelligence

algorithms in the military sphere and surveillance systems – was significant, as it demonstrated a new stage in the relationship between technological progress, global competition, and the issues of ethical oversight. (The Washington Post, 2025, February 4). Google's decision was explained by the new conditions of geopolitical instability, the increasing importance of national security, and the need to adapt corporate policy to contemporary challenges. Whereas the previous emphasis had been on the risks of human rights violations and the inadmissibility of using AI in armed conflicts, in 2025 the corporation announced its intention to cooperate with state institutions to develop technologies that would align with democratic values and the principles of international law. Thus, Google sought to position itself not as an uncontrolled player in the global market, but as an actor striving to integrate technological progress with a framework of legal and humanistic coordinates. This transformation of Google's policy is merely part of a broader trend observed in the technology industry in recent years. Other digital market giants, notably Microsoft and Amazon, have for a long time maintained close ties with US defence structures, developing tools for data processing, cybersecurity, and the management of complex operations. In this context, Google's position can be interpreted as a compelled move, driven not so much by a change in internal corporate priorities as by the intensification of international competition in the field of military technologies, particularly the active development of autonomous systems in China and several other states seeking leadership in the defence applications of AI.

The internal protest of Google employees against the company's involvement in Project Maven has gained particular significance in the discussion of new ethical guidelines (The New York Times, 2018, April 4). This was an initiative of the US Department of Defense, which envisaged the use of Google's algorithms to analyse military video data and identify targets (Mozur & Wakabayashi, 2018, June 1). Widespread employee dissatisfaction, which led the company to withdraw from the project in 2019, vividly demonstrated the conflict between a corporate culture oriented towards humanistic and democratic values, on the one hand, and state interests aimed at strengthening military capabilities, on the other. Despite the policy change in 2025, the company's leadership emphasised that any cooperation with government institutions would be conducted in compliance with international law and with due consideration of the risks of misuse.

The Google example has served as a kind of indicator of the overall dynamics in the field of AI ethics: major technology corporations cannot remain aloof from military and political processes, yet at the same time must take into account societal demands for transparency, accountability, and oversight. The situation revealed a profound paradox of the modern era: technologies that have the potential to protect democratic values can simultaneously undermine them if applied in an uncontrolled or irresponsible manner.

## 3. Ukraine's National Interests in the Context of International Regulation of Autonomous Weapons

In the realm of national security and international relations, the issue of using AI in autonomous weapons systems has acquired particular urgency. Such systems are capable of making decisions on the use of force without human involvement, fundamentally altering the nature of contemporary armed conflicts. On the one hand, their integration may enhance state capabilities in defence and create new forms of strategic advantage. On the other hand, autonomous technologies remain beyond traditional ethical and legal standards, as their functioning does not adhere to principles of humanity, accountability, or proportionality. In this context, the study of the ethical boundaries of AI use in warfare and the development of legal mechanisms for its international regulation emerges as one of the most pressing tasks for contemporary science and practice (The Washington Post, 2025, February 4).

Another important aspect is Ukraine's participation in international initiatives aimed at preventing the uncontrolled militarisation of artificial intelligence. In particular, within the framework of UN discussions on the prohibition or limitation of autonomous weapons systems, the Ukrainian side has repeatedly expressed the position that the role of international law and collective oversight mechanisms should be strengthened (United Nations, 2024, October 2). This reflects the state's endeavour to align its national interests with global security, which is particularly significant in the context of the ongoing russian aggression. However, a key issue remains the absence of a clear international consensus regarding the status of autonomous weapons. Some countries, including the United States and China, oppose a complete ban on such systems, arguing for their strategic importance to national defence. At the same time, a number of European states, as well as international human rights organisations, call for the introduction of preventive restrictions and the establishment of a universal treaty similar to the Convention on Cluster Munitions or the Ottawa Convention on the Prohibition (United Nations, 2008, May 30) of Anti-Personnel Mines (United Nations, 1997, September 18). For Ukraine, this discussion carries a dual significance. On the one hand, integration into the Western security space requires the alignment of legal norms with NATO and EU standards, which increasingly emphasise the humanitarian dimension of the use of military technologies. On the other hand, the country is at war, where any advanced means of defence can be crucial for protecting sovereignty. This creates a complex dilemma: how to ensure state security without exceeding international obligations or violating ethical principles.

In view of the challenges associated with the use of autonomous weapons, there arises a need for not only technical and legal, but also ethical consideration of this issue. To ensure the safe and controlled integration of such technologies into the military sphere, it is important to establish effective oversight mechanisms, harmonise national legislation with

international standards, and participate in global initiatives. In this context, it is appropriate to summarise the key aspects of the issue of civilian oversight of autonomous weapons systems in Ukraine, as presented in *Table 1*.

*Table 1*

Key Aspects of the Issue of Civilian Oversight of Autonomous Weapons Systems in Ukraine

| Aspect | Problems | Potential Solutions |
|---|---|---|
| Legislative Regulation | Absence of clear norms for the control of autonomous systems | Development of specific legislative acts regulating the use of such systems |
| Constitutional Provisions | General provisions without specific details regarding autonomous weapons | Expansion of the legal framework taking into account the specifics of autonomous combat technologies |
| Effectiveness of Autonomous Systems | Increased combat effectiveness accompanied by security risks | Establishment of ethical and legal limitations on the use of autonomous systems |
| International Standards | Lack of a unified legal framework at the global level | Participation in international initiatives and the development of global regulatory standards |
| Rapid Technological Development | Regulatory framework lags behind the pace of innovation | Updating national and international legislation in accordance with technological changes |
| Civilian Oversight | Absence of monitoring and accountability mechanisms | Implementation of independent oversight, ethical committees, and audits of system use |

*Table 1* summarises the key problem areas that hinder effective civilian oversight of autonomous weapons systems in Ukraine.

As evidenced by the data summarised in *Table 1*, the issue of civilian oversight of autonomous weapons systems in Ukraine is multifaceted, encompassing a range of aspects – from the imperfection of national legislation and the absence of specific regulatory provisions to the lack of international standards that would ensure a unified approach to the regulation of emerging combat technologies. This situation requires not only local solutions to individual problems but also a systemic analysis in a broader context, integrating national and global levels of legal, ethical, and political regulation.

## 4. International Legal Regulation and the Architecture of Accountability in the Field of Autonomous Weapons

In the course of the research, it becomes evident that autonomous weapons systems are not a straightforward phenomenon. They possess both positive aspects, such as the ability to enhance the effectiveness of military operations, reduce risks to personnel, and ensure more precise coordination of actions, and significant negative consequences. Among the latter, particular attention should be given to the risks of losing control over decision-making algorithms, the threat to global security in the event of widespread deployment of such systems without proper regulation (United Nations, 2024, October 2), and the danger of their use in violation of international humanitarian law. The problem is further compounded by the

fact that the existing legal systems of states, including Ukraine, do not always contain clear mechanisms and guidelines regarding the permissible limits of the use of such technologies, thereby creating a space for misuse and uncontrolled application.

In this context, the development of international standards and a national legislative framework that clearly delineates the boundaries for the use of autonomous weapons systems emerges as a necessary step to ensure the legality, humanity, and transparency of their deployment. It is important to emphasise that the legal framework must be dynamic and flexible, as AI technologies develop at an exceptionally rapid pace and continually give rise to new challenges. Therefore, the adaptation of legislative norms should occur within the framework of international legal regulation, which is capable of establishing universal standards for all participating states and minimising the risks of chaotic or selective use of autonomous systems in armed conflicts.

For Ukraine, this task carries particular significance. The establishment of internal regulations that integrate technical, ethical, and legal requirements will enable the implementation of an effective mechanism for civilian oversight (Ministry of Digital Transformation of Ukraine, 2023, October 7). This will promote transparency in the development and deployment of autonomous technologies, prevent their potential misuse, and ensure accountability of all actors, from engineers and scientists to military commanders and political leaders.

The formation of such a comprehensive control system requires the harmonisation of several components: international law, ethical principles, and scientific developments. The mutual integration of these elements can create a distinct architecture of accountability and responsibility, grounded in the principles of humanism, transparency, and collective security. At the same time, international cooperation based on dialogue and trust will play a decisive role in the establishment of global standards that define the permissible limits for the use of autonomous weapons systems. The further development of the international legal framework envisages the conclusion of new agreements and conventions capable of establishing clear requirements regarding the stages of development, testing, and practical deployment of autonomous systems. This will help to avoid dangerous fragmentation and disorder in the field of military innovations, which could otherwise pose a threat both to individual nation-states and to the global community as a whole (United Nations, 2024, September 22).

## 5. Proposals for the Integration of Ethical and Legal Mechanisms in the Use of Autonomous Weapons Systems

Particular attention should be given to the issue of transparency in the functioning of autonomous algorithms. This refers to the openness of decision-making processes, which enables independent auditing, verification of compliance with international humanitarian standards, and timely responses

to identified risks. The implementation of independent monitoring and auditing mechanisms is crucial for reducing the risk of misuse and strengthening public trust in emerging technologies. Furthermore, it is essential to establish clear legal frameworks that define the boundaries and degree of accountability for the actions of autonomous systems. This entails the allocation of duties and responsibilities among software developers, military organisations operating the technologies, and political institutions making strategic decisions. Responsibility should neither be diffuse nor collectively shared. Legal mechanisms must ensure both personal and institutional accountability at all stages of a technology's lifecycle: from conceptual design and development to practical deployment on the battlefield. The ethical dimension of employing autonomous combat systems should constitute an integral component of their regulation. This includes the development of dedicated ethical codes for engineers, scientists, and military specialists working with such technologies (IEEE, 2019), as well as the establishment of global educational programmes for military personnel (UNESCO, 2021). Such programmes ought to address issues of international humanitarian law, moral responsibility, and the principles of humanity in conditions of armed conflict. It is through these measures that a conscious approach to the use of autonomous systems can be cultivated, one that reconciles technological advancement with fundamental human values.

Within a comprehensive approach to regulating the use of autonomous combat systems, particular importance is attached to the consideration of humanitarian aspects, which directly concern the protection of civilian populations in armed conflict zones. One of the primary objectives of contemporary combat algorithms should be the ability to clearly distinguish between combatants and civilians, thereby minimising risks to non-combatants and preventing violations of international humanitarian law (International Committee of the Red Cross, 1977, June 8). An important component of this process is also the integration of autonomous systems into humanitarian and peacekeeping missions, where their deployment can contribute to reducing levels of violence, safeguarding civilian infrastructure, and ensuring compliance with international humanitarian law.

At the same time, the harmonisation of national legislation with international standards has become a primary task for Ukraine. Integrating the national legal system into the global regulatory architecture for autonomous weapons will allow existing inconsistencies to be resolved and a coherent approach to their use to be established. Such integration is not only a legal imperative but also a political necessity, as it fosters trust between states and contributes to the formation of collective security on a global scale. Equally significant is the expansion of Ukraine's cooperation with international organisations, foremost among them NATO and the United Nations. Joint initiatives have the potential to lay the groundwork for the development of universal strategies aimed at preventing the uncontrolled proliferation of autonomous combat systems, their deployment in contexts posing risks to

civilian populations, and the minimisation of threats to global stability (NATO / ARROWS Law Firm, 2025; Bendett & Kirichenko, 2025).

Thus, effective oversight of emerging military technologies should be based on a multi-layered system combining intergovernmental coordination, national legislative regulation, mechanisms for ethical supervision, and independent technological auditing. Only such an integrated approach can ensure a balance between innovative development in the defence sector and adherence to humanitarian principles, which form the foundation of the international legal order.

To summarise the key directions for addressing the issues outlined, it is appropriate to refer to *Table 2*, which systematises the principal challenges alongside the corresponding strategic measures aimed at establishing an effective and ethically grounded policy in the field of autonomous weapon systems.

*Table 2*

Solutions to Issues Related to Autonomous Weapon Systems

| Problem | Solutions |
|---|---|
| International Norms and Standards | Development of International Treaties and Agreements<br>Implementation of International Standards for Autonomous Systems |
| Accountability | Establishment of Accountability for the Actions of Autonomous Systems<br>Creation of Legal Frameworks to Define Responsibility |
| Transparency and Oversight | Ensuring Algorithmic Transparency<br>Implementation of Oversight and Auditing Mechanisms |
| Ethical Supervision and Training | Development of Ethical Codes<br>Introduction of Mandatory Training Programmes |
| Humanitarian Aspects | Ensuring Autonomous Systems' Capability to Identify Civilians<br>Development of Algorithms Considering Humanitarian Consequences |
| Intergovernmental Cooperation | Strengthening International Cooperation<br>Formation of Intergovernmental Working Groups |

*Table 2* summarises the key directions that should be considered when formulating policy on autonomous combat systems.

## Conclusions

The development of autonomous combat systems presents a complex set of ethical, legal, and technological challenges, requiring an interdisciplinary approach and the integration of knowledge from multiple scientific fields. The absence of harmonised international standards generates significant legal uncertainty in the use of autonomous weapons, thereby creating an urgent need for clear regulation and the establishment of transparent norms. Particular attention should be given to the ethical dimensions of using such systems, as automated decision-making, devoid of moral judgment, may lead to violations of international humanitarian law and undermine the principles of humanity in the conduct of armed conflict.

Simultaneously, autonomous technologies are radically transforming the nature of military operations, bringing to the forefront questions of accountability for the decisions they make. In the context of contemporary armed conflicts, ensuring stringent oversight of the deployment of such systems becomes critically important, as it allows for the minimisation of risks to human rights and the protection of civilian populations. In this regard, the establishment of transparent and effective regulatory mechanisms for the use of autonomous combat technologies assumes a pivotal role in enhancing security, fostering public trust, and maintaining stability within the international system.

Further research should focus on the development and implementation of international standards for the legal regulation of autonomous weaponry, the refinement of national legislative frameworks, and the establishment of ethical principles that ensure a balance between technological advancement and humanistic values. Equally important is the creation of effective mechanisms for civilian oversight, the assurance of transparency in decision-making algorithms, and the delineation of responsibility among developers, military units, and state institutions.

It is precisely the integration of legal, ethical, and technological approaches that forms the foundation for the safe and controlled deployment of autonomous systems in the military domain, contributing to the establishment of a resilient security framework and enhancing public trust in innovative technologies within the defence sector.

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