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I. INTRODUCTION

Artificial Intelligence (AI) has now been integrated in military functions and capabilities, including autonomous weapons, threat detection, and decision-support tools, and has become part of the security doctrines of several countries. In spite of its increasing role, the legal implications of the use of AI systems in military contexts have been mainly studied from the perspective of the *jus in bello*, that is, when these systems are employed *during* an armed conflict, whilst they have so far not received much attention from international law scholarship when they affect decisions to *initiate* a use of armed force, which raises pressing *jus ad bellum* questions. The present article intends to fill this gap in the literature.

The UN General Assembly has recalled that "international law, including the Charter of the United Nations . . . applies to matters governed by it that occur throughout all stages of the life cycle of artificial intelligence, including systems enabled by artificial intelligence, in the military domain."[1] In the *Nuclear Weapons* Advisory Opinion, the International Court of Justice (ICJ) also found that the provisions on the use of force contained in the UN Charter, including Article 51, "do not refer to specific weapons. They apply to any use of force, regardless of the weapons employed."[2] There is no doubt, therefore, that existing international law, including the *jus ad bellum* rules, applies to the use of AI in the military domain.

The question is whether AI constitutes an asset or rather a challenge for the application of these rules, as current legal frameworks imply human judgment: introducing AI fundamentally shifts assumptions about agency, responsibility, and the conceptual basis of legal assessments. The present article explores this question from the perspective of the right of States to self-defense. More specifically, it examines whether AI can be a helpful tool to ensure the necessity and proportionality of the defensive response. By addressing this issue, the article will serve as a reference for national positions on the military use of AI, help States navigate AI integration responsibly, and contribute to shaping emerging norms in a still-fluid area.

The present article advances two main arguments. The first is that, while AI can perhaps be helpful in identifying incoming threats of armed attacks, abstract and highly context-driven notions like necessity and proportionality

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1. G.A. Res. 79/239, ¶ 1 (Dec. 31, 2024).

2. Legality of the Threat or Use of Nuclear Weapons, Advisory Opinion, 1996 I.C.J. 226, ¶ 39 (July 8) [hereinafter Nuclear Weapons Advisory Opinion].

would be very difficult to translate into computer code. The second is that, even assuming that this was possible, leveraging AI to establish the necessity and proportionality of a self-defense response would entail as many challenges as it does advantages and, therefore, should be approached with caution. To demonstrate these arguments, this article proceeds as follows. Part II recalls how AI has come to play an important role in military and political decision-making, and Part III reviews the applicable legal framework of self-defense under the UN Charter and customary international law. Parts IV and V then respectively explore the opportunities and challenges that the resort to AI systems presents for establishing the necessity and proportionality of a self-defense response.

Before proceeding, two caveats. First, necessity and proportionality also apply to other (accepted or controversial) legal grounds for the use of force, namely UN Security Council enforcement actions under Chapter VII of the Charter and humanitarian intervention.[3] This article, however, limits itself to discussing them in the context of the law of self-defense. Secondly, even though it has been suggested that self-defense can also justify non-forcible measures,[4] the present article will exclusively focus on armed responses.

II. AI SYSTEMS AND MILITARY DECISION-MAKING

Although there is no generally agreed-upon definition, the expression "artificial intelligence" is employed to refer to "the evolving capability of machines to imitate aspects of intelligent human behaviour."[5] The 2024 Council of Europe's Framework Convention on Artificial Intelligence and Human Rights, Democracy and the Rule of Law more specifically defines an AI system as "a machine-based system that, for explicit or implicit objectives, infers, from the input it receives, how to generate outputs such as predictions, content, recommendations or decisions that may influence physical or virtual environments."[6]

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3. On necessity and proportionality as requirements for humanitarian intervention and for enforcement action by the Security Council, *see* JUDITH GARDHAM, NECESSITY, PROPORTIONALITY AND THE USE OF FORCE BY STATES 184–86, 188ff (2009).

4. Russell Buchan, *Non-Forcible Measures and the Law of Self-Defence*, 72 INTERNATIONAL AND COMPARATIVE LAW QUARTERLY 1 (2023).

5. Toni Erskine, Before *Algorithmic Armageddon: Anticipating Immediate Risks to Restraint When AI Infiltrates Decisions to Wage War*, 78 AUSTRALIAN JOURNAL OF INTERNATIONAL AFFAIRS 175, 176 (2024).

6. Council of Europe, Framework Convention on Artificial Intelligence and Human Rights, Democracy and the Rule of Law art. 2, *opened for signature* Sept. 5, 2024, C.E.T.S. No.

In practice, AI consists of "a collection of technologies that combine data, algorithms and computing power."[7] It is presently used primarily as a decision support system (DSS), that is, as a tool that assists humans in making decisions, including in relation to the use of force.[8] AI-based DSSs can be *descriptive* when they merely organize and present data to human decision-makers; *predictive* when they analyze historical data patterns and trends to forecast the probability of future events; or *prescriptive* when they also recommend the best course of action to a human operator.[9] Predictive algorithms, in particular, use statistical tools in order to identify correlations between variables based on the available data and to forecast probabilistic outcomes: the more the available data, the more accurate the output. The unprecedented advantage offered by AI systems is that they can analyze "huge quantities of data quickly, uncovering patterns of correlation in datasets that are beyond human cognition, estimating risks, and predicting the possible outcomes of actions (or inactions)."[10] An AI system can envisage all potential courses of events and select what it believes to be the best action (according to the predefined parameters set by a human operator)[11] from a range of

225. The Convention does not apply to matters related to national defense. *Id.* art. 3(4). For the EU AI Act, an AI system is

> a machine-based system that is designed to operate with varying levels of autonomy and that may exhibit adaptiveness after deployment, and that, for explicit or implicit objectives, infers, from the input it receives, how to generate outputs such as predictions, content, recommendations, or decisions that can influence physical or virtual environments.

Regulation (EU) 2024/1689 of the European Parliament and of the Council, 13 June 2024, art. 3, 2024 O.J. (L 1689).

7. European Commission, *White Paper on Artificial Intelligence: A European Approach to Excellence and Trust*, at 2, COM (2020) 65 final (Feb. 19, 2020). Algorithms have been defined as "computational procedures that take some set of values as inputs and produce some set of values as outputs." Ashley S. Deeks, *Predicting Enemies*, 104 VIRGINIA LAW REVIEW 1529, 1545 (2018).

8. Erskine, *supra* note 5, at 177 (noting AI-based DSS "would metaphorically whisper in the ears of military and political leaders and make appeals and recommendations to executive bodies").

9. INT'L COMM. OF THE RED CROSS & GENEVA ACADEMY, ARTIFICIAL INTELLIGENCE AND RELATED TECHNOLOGIES IN MILITARY-DECISION MAKING ON THE USE OF FORCE IN ARMED CONFLICTS: CURRENT DEVELOPMENTS AND POTENTIAL IMPLICATIONS 9 (Mar. 2024).

10. Erskine, *supra* note 5, at 177.

11. It is not yet possible for AI to pursue general purposes in general contexts ("general artificial intelligence"). Tobias Vestner & Altea Rossi, *Legal Reviews of War Algorithms*, 97 INTERNATIONAL LAW STUDIES 509, 514 (2021).

practically infinite alternatives, taking into account and comparing the risks and advantages of the various options at a speed that would normally be impossible for humans. From a military point of view, this can allow detection of potential threats, tracking enemy movements, identifying and prioritizing targets, and more generally supporting decision-makers in selecting the most effective strategies and tactics.

Another distinction is that between deterministic and stochastic AI systems. While the former generate the same outputs if they receive the same inputs and are therefore largely predictable,[12] the latter can produce different outputs even when the same input is submitted, depending on random or probabilistic factors. Machine learning is a specific type of AI that in most cases incorporates stochastic elements: it uses an algorithm able to create self-learning models and improve its predictive performance on the basis of new data and experience, and can thus adjust to changing situations.[13] Deep learning is a subtype of machine learning that relies on multi-layered artificial neural networks in order to process and understand image, video, speech, and audio data.[14] Project Maven, for instance, is a U.S. Department of Defense project launched in 2017 that integrates deep learning and other AI into military operations to process and analyze vast amounts of video data from drones and surveillance systems with the ultimate purpose of identifying and categorizing objects of interest.[15]

Some AI-based DSSs include, or at least control, a physical component that allows them to also implement a decision and turn it into a physical action, as in the case of autonomous weapon systems (AWSs).[16] Unlike other

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12. *Id.* at 539. Even in this case, however, small input changes can lead to very significant output differences. *Id.* at 540.

13. Erskine, *supra* note 5, at 177; Deeks, *supra* note 7, at 1531. Machine learning can be supervised (when a human operator closely monitors the learning process by categorizing the data inputs fed into the system) or self-learning (when the system is trained without guidance by labelled data). *See* Antje von Ungern-Sternberg, *Artificial Agents and General Principles of Law*, 60 GERMAN YEARBOOK OF INTERNATIONAL LAW 239, 244–45 (2017).

14. Ana Beduschi, *Harnessing the Potential of Artificial Intelligence for Humanitarian Action: Opportunities and Risks*, 104 INTERNATIONAL REVIEW OF THE RED CROSS 1149, 1151 (2022). Artificial neural networks are computational models inspired by the human brain and consisting of nodes (neurons) organized in layers.

15. ICRC & GENEVA ACADEMY, *supra* note 9, at 14.

16. *Id.* at 9. An autonomous weapon system is "[a] weapon system that, once activated, can select and engage targets without further intervention by an operator." U.S. DEP'T OF DEF., DIRECTIVE 3000.09, AUTONOMY IN WEAPON SYSTEMS 21 (Jan. 25, 2023), www.esd.whs.mil/portals/54/documents/dd/issuances/dodd/300009p.pdf [hereinafter U.S. DOD DIRECTIVE 3000.09]. Not all AWSs, however, use AI. *See* Dominik Steiger, *Employment of AI*

DSSs, AWSs are aimed at *replacing*, not merely assisting, humans in performing certain functions.[17] These systems can be further distinguished into fully autonomous, semi-autonomous, and human-supervised.[18] Fully autonomous systems are those where there is minimal or no human supervision during the operational phase, although humans remain involved in the development and deployment of the system.[19] Some autonomous systems with limited artificial intelligence (mainly for threat analysis, interception decisions, and optimization of launch timing and resources) are already in use, as in the case of Israel's Iron Dome.[20]

The question is whether the use of AI systems can facilitate compliance with the requirements of necessity and proportionality in the exercise of the right of self-defense by States, or whether they complicate it further. Before moving to address this problem, Part III will recall the relevant legal framework.

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in Decisions on the Use of Force, *in* RESEARCH HANDBOOK ON WARFARE AND ARTIFICIAL INTELLIGENCE 136, 141 (Robin Geiß & Henning Lahmann eds., 2024).

17. That said, it has been observed that the distinction between AWSs and AI-enabled DSS might not always be clear cut "because the functionality of a system can be determined by its context—its configuration, rules of engagement and operational command—rather than by its intrinsic properties." ALEXANDER BLANCHARD & LAURA BRUUN, AUTONOMOUS WEAPON SYSTEMS AND AI-ENABLED DECISION SUPPORT SYSTEMS IN MILITARY TARGETING 6 (June 2025), www.sipri.org/publications/2025/other-publications/autonomous-weapon-systems-and-ai-enabled-decision-support-systems-military-targeting-comparison-and.

18. Agata Kleczkowska, *Autonomous Weapons and the Right to Self-Defence*, 56 ISRAEL LAW REVIEW 24, 25–26 (2023). Ten levels of automation have been identified. *See* Karina Vold, *Human-AI Cognitive Teaming: Using AI to Support State-Level Decision Making on the Resort to Force*, 78 AUSTRALIAN JOURNAL OF INTERNATIONAL AFFAIRS 229, 231 (2024). Autonomy is "the ability of a system to operate within an environment in pursuit of its goal without direct or real-time human control." Samuli Haataja, *Autonomous Cyber Capabilities and International Law on the Use of Force, Self-Defence, Intervention, and Sovereignty*, AUSTRALIAN ARMY OCCASIONAL PAPER NO. 25, at 8 (Nov. 12, 2024).

19. Kleczkowska, *supra* note 18, at 29.

20. *Id.* at 26–27.

III. The Inherent Right of States to Self-Defense and the Necessity and Proportionality of the Response to the Armed Attack

As is well known, the rules on the use of armed force are contained in the Charter of the United Nations and in the corresponding customary international law. Under this legal framework, the threat and use of armed force in international relations are prohibited (Article 2(4) of the Charter), but States remain entitled to forcibly react in self-defense even without the authorization of the UN Security Council (Article 51).

States can exercise the right of self-defense exclusively in response to an armed attack. An armed attack has been identified by the ICJ in the *Nicaragua* judgment as a use of armed force that is serious because of its scale and effects.[21] In relation to the temporal element of an armed attack, three situations can be distinguished. First, the armed attack could have started (whether or not damage has already occurred)[22] and not be over yet: in this case, it is uncontroversial that the right of self-defense can be exercised to halt the ongoing attack and avert further damage. Second, the armed attack could have started, caused damage, and ceased, in which case two situations can be envisaged: no further attacks are reasonably foreseeable, or the attack was only an element of a broader campaign. In the former case, an armed response is not allowed unless it occurs within a reasonable time frame following the armed attack, as otherwise it would constitute a prohibited reprisal rather than a defensive measure.[23] In the latter, on the other hand, it is generally accepted that self-defense can be lawfully exercised in order to pre-

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21. Military and Paramilitary Activities in and Against Nicaragua (Nicar. v. U.S.), Judgment, 1986 I.C.J. 14, ¶ 195 (June 27) [hereinafter Nicaragua Judgment]. There are, however, other views. The United States, in particular, sees the expressions "use of force" in Article 2(4) and "armed attack" in Article 51 as coterminous. OFF. OF THE GEN. COUNSEL, U.S. DEP'T OF DEFENSE, LAW OF WAR MANUAL § 1.11.5.2 (updated ed. July 2023).

22. Dinstein refers to a response against an armed attack that has started but not yet produced its effects as "interceptive" self-defense. YORAM DINSTEIN, WAR, AGGRESSION AND SELF-DEFENCE 231 (6th ed. 2017).

23. RUSSELL BUCHAN & NICHOLAS TSAGOURIAS, REGULATING THE USE OF FORCE IN INTERNATIONAL LAW: STABILITY AND CHANGE 66 (2021). Dinstein, however, argues in favor of the legality of armed reprisals, that is, "post-attack measures of self-defence 'short of war,'" when their motive is deterrence and not mere punishment. DINSTEIN, *supra* note 22, at 270–71.

empt the repetition of the attack.[24] Third and finally, the armed attack could have not started yet, which also leads to distinguishing two situations: the attack could be imminent or merely possible. An anticipatory reaction in self-defense in the former case is considered permissible by several scholars,[25] while a preventive response in the latter case has no basis whatsoever either in the letter of Article 51 or in the general practice and *opinio juris* of States.[26] If anticipatory self-defense is considered part of customary international law—a point that remains debated[27]—the standard of imminence must be interpreted with utmost stringency. This requires that, even if an armed attack has not yet commenced, its occurrence is unavoidable and is temporally close enough so that there is genuinely no time to pursue alternatives to an armed defensive response.

If the actual or, for the supporters of anticipatory self-defense, at least imminent occurrence of an armed attack is established, and leaving aside the question whether the author of the armed attack must be a State or can also be a non-State actor,[28] what the victim State needs to demonstrate is that the use of force in self-defense is necessary to counter the armed attack and that its modalities and effects are not disproportionate. Necessity and "moderation" were already emphasized as requirements of the defensive reaction by the classical scholars. Grotius, for instance, maintained that "[w]ar in defence of life is permissible only when the danger is immediate and certain, not when it is merely assumed,"[29] and only if the danger cannot be in any other way avoided.[30] Suárez also argued that the "natural and necessary" right of

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24. TOM RUYS, 'ARMED ATTACK' AND ARTICLE 51 OF THE UN CHARTER 102 (2010); David Kretzmer, *The Inherent Right to Self-Defence and Proportionality in* Jus ad Bellum, 24 EUROPEAN JOURNAL OF INTERNATIONAL LAW 235, 270 (2013); Michael N. Schmitt, *Counter-Terrorism and the Use of Force in International Law*, THE MARSHALL CENTER PAPERS, No. 5, at 24 (Jan. 2002).

25. *See, e.g.*, Michael N. Schmitt, *Preemptive Strategies in International Law*, 24 MICHIGAN JOURNAL OF INTERNATIONAL LAW 513, 535 (2003); RUYS, *supra* note 24, at 255–57 (cited authors).

26. RUYS, *supra* note 24, at 526–27.

27. *See, e.g.*, *id.* at 527; Kevin Jon Heller, *The "Last Window of Opportunity" Test is Not the Law—And Shouldn't Be*, OPINIO JURIS, (June 24, 2025), https://opiniojuris.org/2025/06/24/the-last-window-of-opportunity-test-is-unlawful-and-dangerous/.

28. On this problem, *see* RUYS, *supra* note 24, at 419ff.

29. HUGO GROTIUS, DE JURE BELLI AC PACIS [ON THE LAW OF WAR AND PEACE], bk. II, ch. I, sec. V (Francis W. Kelsey trans., 1964) (1625).

30. *Id.* at 175.

self-defense had to be exercised with moderation.[31] Daniel Webster's letter to Henry Fox in relation to the sinking of the steamboat *Caroline* claimed that the extent of the right of self-defense "is a question to be judged of by the circumstances of each particular case, and when its alleged exercise has led to the commission of hostile acts within the territory of a Power at peace, nothing less than a clear and absolute necessity can afford ground for justification."[32] Webster then famously subordinated a defensive use of force to "a necessity of self-defence, instant, overwhelming, leaving no choice of means, and no moment for deliberation."[33] In his view, self-defense allows "nothing unreasonable or excessive; since the act, justified by the necessity of self-defence, must be limited by that necessity, and kept clearly within it."[34] Although they are not explicitly indicated in Article 51 of the Charter, necessity and proportionality uncontroversially remain requirements of a reaction in self-defense under existing customary international law.[35]

Necessity and proportionality must not be confused with the requirement of the occurrence of an armed attack. The latter is what triggers the exercise of the right of self-defense, while the former are elements of the response to an armed attack that can be assessed only after establishing that an armed attack is occurring. They are thus discrete requirements of a lawful reaction in self-defense: the mere fact that an armed attack occurs does not automatically entail that an armed defensive response is necessary or that its modalities and effects are proportionate.[36] It is also worth recalling that necessity and proportionality apply throughout the whole duration of the defensive reaction, not just at the moment of the initial decision to use force: "what is required to pursue a defensive objective will change over time as the nature and scale of the conflict ebbs and flows. Developments on the

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31. Francisco Suárez, *Disputation XIII: The Three Theological Virtues: On Charity*, *in* SELECTION FROM THREE WORKS OF FRANCISCO SUÁREZ 804 (Thomas Pink ed., Gwladys L. Williams, Ammi Brown & John Waldron trans., 1944) (1621).

32. Letter from Daniel Webster, U.S. Secretary of State, to Henry Fox, British Minister in Washington (Apr. 24, 1841), 29 BRITISH AND FOREIGN STATE PAPERS 1840–1841, at 1129, 1132–33.

33. *Id.* at 1137–38.

34. *Id.* at 1138.

35. Nicaragua Judgment, *supra* note 21, ¶ 176; Nuclear Weapons Advisory Opinion, *supra* note 2, ¶ 41.

36. CHRIS O'MEARA, NECESSITY AND PROPORTIONALITY AND THE RIGHT OF SELF-DEFENCE IN INTERNATIONAL LAW 36 (2021).

ground might mean that what is a proportionate response at one point in the conflict might later become disproportionate."[37]

Establishing the necessity and proportionality of a defensive response to an armed attack essentially involves answering two questions: 1) Are any alternatives to the use of armed force in self-defense reasonably available to the victim State? 2) If not, are the modalities and effects of the response appropriate and justified in achieving the goal of defending against the armed attack? The first question essentially determines whether there is a need at all for resorting to armed force, while the second establishes whether the response has been conducted for any purpose other than a defensive one. It is worth pointing out that necessity and proportionality in the law of self-defense are best seen as two sides of the same coin: as Tom Ruys notes, there is no clear separation between the two as they both stem from the purpose of the self-defense reaction, which is to counter an armed attack.[38] David Kreztmer goes further and concludes that "proportionality in *jus ad bellum* is not really proportionality at all, but purely a question of whether the force was necessary to achieve the legitimate ends of using force in self-defence."[39]

A. The Necessity Test: Are Any Alternatives to the Use of Armed Force in Self-Defense Reasonably Available to the Victim State?

The necessity test determines whether armed force is really required to defend against the armed attack or whether non-forcible means are sufficient in the specific circumstances of the case. To borrow the *Caroline* correspondence language, when the need for self-defense is neither instant nor overwhelming and there is a choice of means and moment for deliberation, the armed reaction remains impermissible under the existing law of self-defense. That a use of force is necessary essentially means that, without resorting to it, the victim State would not be able to effectively protect itself from the armed attack, as other measures would be unhelpful: as Special Rapporteur Roberto Ago put it, "had [the victim State] been able to achieve the same

37. *Id.* at 170; *see also* Kretzmer, *supra* note 24, at 267–68.

38. RUYS, *supra* note 24, at 123; *see also* CHRISTIAN HENDERSON, THE USE OF FORCE IN INTERNATIONAL LAW 237 (2018); GABRIELLA VENTURINI, NECESSITÀ E PROPORZIONALITÀ DELLA FORZA MILITARE IN DIRITTO INTERNAZIONALE 34 (1988); Geoffrey S. Corn, *The Essential Link Between Proportionality and Necessity in the Exercise of Self-Defense*, *in* NECESSITY AND PROPORTIONALITY IN INTERNATIONAL PEACE AND SECURITY LAW 79, 88 (Claus Kreß & Robert Lawless eds., 2020); CHRISTINE GRAY, INTERNATIONAL LAW AND THE USE OF FORCE 159 (4th ed. 2018).

39. Kretzmer, *supra* note 24, at 282.

result by measures not involving the use of armed force, it would have no justification for adopting conduct which contravened the general prohibition against the use of force."[40] Non-forcible alternatives could, for instance, include an attempt at negotiations, the adoption of economic sanctions against the aggressor State, resort to law enforcement operations, and the use of passive or active cyber defenses short of force (if the armed attack was carried out by cyber means). The necessity test, however, does not require that non-forcible options have been attempted and failed, but only that it could be *reasonably* anticipated that they would fail if attempted.[41]

Imminence and immediacy are important indicators that there were no other means reasonably available to the victim State to protect itself from the armed attack.[42] Imminence refers to the threat that the self-defense reaction aims to avert, that is, the armed attack, and determines how long *before* an armed attack starts it is permissible to react. If an armed attack is ongoing, there clearly is an "almost irrebuttable presumption" that other non-forcible options are inadequate to respond to the attack.[43] Indeed, in such case "to require a state to attempt peaceful methods of resolution, *instead* of using defensive force, is to abrogate the right of self-defence."[44] If the armed attack has not started yet, the more temporally close it is the more necessary it will likely be to use armed force to defend against it. In anticipatory self-defense, therefore, necessity becomes "a critical gateway" for considering whether non-forcible alternatives were feasible on the basis of the circumstances of

40. Roberto Ago, *Addendum to the Eighth Report on State Responsibility*, [1980] 2 YEARBOOK OF THE INTERNATIONAL LAW COMMISSION 69.

41. James A. Green, *Docking the Caroline: Understanding the Relevance of the Formula in Contemporary Customary International Law Concerning Self-Defense*, 14 CARDOZO JOURNAL OF INTERNATIONAL AND COMPARATIVE LAW 429, 456 (2006).

42. I prefer to see imminence and immediacy as indicators of necessity (intended as non-availability of non-forcible defensive means against the armed attack) rather than as its components (*see* RUYS, *supra* note 24, at 99) or as separate requirements in addition to necessity and proportionality (*see* DINSTEIN, *supra* note 22, at 252).

43. Dapo Akande & Thomas Liefländer, *Clarifying Necessity, Imminence, and Proportionality in the Law of Self-Defence*, 107 AMERICAN JOURNAL OF INTERNATIONAL LAW 563, 564 (2013). The situation might be different if hostilities have ceased but the armed attack has allowed the aggressor to occupy the victim State's territory. Even though the armed attack technically continues because of the occupation, it might be possible to negotiate the invader's withdrawal. OSCAR SCHACHTER, INTERNATIONAL LAW IN THEORY AND PRACTICE 152–53 (1991).

44. O'MEARA, *supra* note 36, at 58 (emphasis in the original).

each case.[45] The threat must be demonstrated to be real, serious, and temporally close enough to render the resort to alternative means futile.

Immediacy, on the other hand, refers to the response to the armed attack and determines how long *after* an armed attack such a response can take place.[46] If the armed attack is ongoing, States do not necessarily have to start the armed response immediately after the attack has begun: it is generally accepted that immediacy, in this context, needs to be considered flexibly, taking the circumstances of the case into account, for instance difficulties with establishing the attribution of the armed attack, the geographical distance of the concerned area, the temporary inability of the victim State to react, or the attempts of the victim State to resort to non-forcible alternatives.[47] A delay in responding in self-defense against an armed attack that has stopped, on the other hand, might suggest that the response was not really necessary, but rather constituted an armed reprisal. In the *Nicaragua* judgment, for instance, the ICJ found that the measures adopted by the United States in and against Nicaragua "were only taken, and began to produce their effects, several months after the major offensive of the armed opposition against the Government of El Salvador had been completely repulsed (January 1981), and the actions of the opposition considerably reduced in consequence."[48] They were therefore not necessary to eliminate the threat against the Salvadorian government. While there is no fixed deadline by when the right of self-defense must be exercised after the initial armed attack has ceased, the more temporally distant the response the less likely it is that the victim State needed it to defend itself.[49] As Olivier Corten points out, the response must be aimed "at behaviour that is still current, even if the material effects of its latest manifestation have already disappeared."[50]

Not only must non-forcible alternatives not be reasonably available, the UN Security Council must also not be taking measures necessary to maintain international peace and security. If it does, a case that is expressly mentioned in Article 51 of the Charter, the exercise of the inherent right of self-defense is suspended because, like in domestic legal systems, it becomes unnecessary when a public authority takes charge of the protection of the community

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45. Akande & Liefländer, *supra* note 43, at 564.

46. Green, *supra* note 41, at 469.

47. DINSTEIN, *supra* note 22, at 287–88; RUYS, *supra* note 24, at 100.

48. Nicaragua Judgment, *supra* note 21, ¶ 237.

49. RUYS, *supra* note 24, at 102.

50. OLIVIER CORTEN, THE LAW AGAINST WAR: THE PROHIBITION ON THE USE OF FORCE IN CONTEMPORARY INTERNATIONAL LAW 483 (2d ed. 2021).

members.[51] The *travaux préparatoires* of the Charter confirm that only those Security Council measures that are adequate to effectively maintain international peace and security can suspend the right of States to self-defense.[52] It is not the type of measure adopted by the Security Council that matters. In particular, it is not required that the Council replaces the right of self-defense "with its functional equivalent, that is, collective intervention on behalf of the aggrieved state."[53] What counts to freeze the exercise of the right of self-defense is that, whatever measure the Council adopts, it is effective in maintaining international peace and security in the specific circumstances of each case.[54]

B. *The Proportionality Test: Are the Modalities and Effects of the Self-Defense Response Justifiable in Light of the Purpose of Defending Against the Armed Attack?*

Once established that armed force is needed to defend against the armed attack, as no other option is reasonably available to the victim State, the second question requires the determination of the response's appropriate modalities and acceptable effects. This is the proportionality test.

Proportionality in the law of self-defense has been interpreted in at least two possible ways. First, it could be seen as implying a balance between the scale and effects of the armed attack and those of the response to it (quantitative doctrine of proportionality).[55] There is some support in the ICJ case-

51. As Neff puts it, "[t]he more prompt and effective the UN Security [Council] was, the smaller a part would self-defence naturally play." STEPHEN C. NEFF, WAR AND THE LAW OF NATIONS 237 (2005).

52. Jutta Brunnée, *The Security Council and Self-Defence: Which Way to Global Security?*, *in* THE SECURITY COUNCIL AND THE USE OF FORCE: THEORY AND REALITY 128 (Niels Blokker & Nico Schrijver eds., 2005); Malvina Halberstam, *The Right to Self-Defense Once the Security Council Takes Action (1995–1996)*, 17 MICHIGAN JOURNAL OF INTERNATIONAL LAW 229, 240–41 (1996).

53. Craig Scott et al., *A Memorial for Bosnia: Framework of Legal Arguments Concerning the Lawfulness of the Maintenance of the United Nations Security Council's Arms Embargo on Bosnia and Herzegovina*, 16 MICHIGAN JOURNAL OF INTERNATIONAL LAW 1, 69 (1994).

54. Marco Roscini, *On the "Inherent" Character of the Right of States to Self-Defence*, 4 CAMBRIDGE JOURNAL OF INTERNATIONAL AND COMPARATIVE LAW 634, 654–55 (2015). *See also* DEREK W. BOWETT, SELF-DEFENCE IN INTERNATIONAL LAW 196 (1958); HANS KELSEN, THE LAW OF THE UNITED NATIONS: A CRITICAL ANALYSIS OF ITS FUNDAMENTAL PROBLEMS 801–2 (1950).

55. *See, e.g.*, ROBERT KOLB, INTERNATIONAL LAW ON THE MAINTENANCE OF PEACE: *JUS CONTRA BELLUM* 409 (2018).

law for this understanding of proportionality. In *Oil Platforms*, in particular, the ICJ found that "the destruction of two Iranian frigates and a number of other naval vessels and aircraft. . . . [a]s a response to the mining, by an unidentified agency, of a single United States warship, which was severely damaged but not sunk, and without loss of life" could not be considered a proportionate use of force in self-defense.[56]

Mainstream scholarship, however, argue that proportionality is not a quantitative assessment but rather a teleological one: the scale and effects of the defensive reaction must be balanced not against those of the armed attack but against the purpose of defending against it.[57] The ICJ appears to have applied this teleological approach where it posited that not even the use of the most destructive weapons, that is, nuclear weapons, can be ruled out when the very survival of the victim State is at stake.[58] The teleological understanding of proportionality is indeed preferable: if the quantitative doctrine were applied, it could potentially lead to depriving a State of the only effective means to defend itself against an armed attack, thus resulting in the denial of a right that the Charter qualifies as "inherent."[59] This does not mean, however, that quantitative factors are entirely irrelevant in the assessment of proportionality. On the contrary, they serve as crucial indicators in determining whether the response exceeds the goal of defending against the armed attack.[60] Said otherwise, the quantitative factors "act as a check on the

56. Oil Platforms (Iran v. U.S.), Judgment, 2003 I.C.J. 161, ¶ 77 (Nov. 6).

57. The purpose of the armed response cannot be punishment or broad deterrence. As Special Rapporteur on State Responsibility, Roberto Ago, famously noted, "the objective to be achieved by the conduct in question, its raison d'être, is necessarily that of repelling an attack and preventing it from succeeding, and nothing else." Ago, *supra* note 40, at 69. Repelling the armed attack involves "not only resistance to an ongoing armed attack but the expulsion of an invader and the restoration of the territorial *status quo ante bellum*." GARDHAM, *supra* note 3, at 156. Geoffrey Corn notes that "[b]y limiting the justified response to only that amount of force absolutely necessary to reduce the threat, proportionality operates to mitigate the risk of a justified self-defense response morphing into an unjustified use of military force to achieve objectives unrelated to self-defense." Geoffrey S. Corn, *Self-defense Targeting: Blurring the Line Between the* Jus ad Bellum *and the* Jus in Bello, 88 INTERNATIONAL LAW STUDIES 57, 67 (2012).

58. Nuclear Weapons Advisory Opinion, *supra* note 2, ¶ 97; *see also* Nuclear Weapons Advisory Opinion, *supra* note 2, ¶ 5 (Higgins, J., separate opinion) (Judge Higgins's reading of the *Nicaragua* Judgment).

59. O'MEARA, *supra* note 36, at 123. On the meaning of "inherent," *see* Roscini, *supra* note 54, at 642–48.

60. Green, *supra* note 41, at 461.

pursuit of a defensive purpose,"[61] that is, as evidence that the response is kept as a whole within the limits of such purpose and does not become merely punitive.

Commentators have singled out the duration and geographical scope of the armed response, the choice of targets and weapons, and the damage caused as the factors to consider to assess the proportionality of a self-defense response to an armed attack.[62] Starting from the first, the temporal scope of a defensive reaction depends on that of the threat: to be proportionate, the reaction may only last until the armed attack has been neutralized.[63] In the *Nicaragua* judgment, for instance, the ICJ found that one of the reasons why the U.S. activities against the Central American country did not meet the criterion of proportionality was that they "continued long after the period in which any presumed armed attack by Nicaragua could reasonably be contemplated."[64]

Unlike in intervention by invitation,[65] the geographical scope of the armed response in self-defense can extend to the territory of the aggressor State, but to be proportionate it must, in principle, be limited to the areas from where the armed attack is launched.[66] This is evident when the armed attack is localized, as in the case of Argentina's invasion of the Falkland Islands.[67] It also finds support in the *Armed Activities* judgment, where the ICJ held that the taking of airports and towns many hundreds of kilometers from

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61. O'MEARA, *supra* note 36, at 126.

62. GARDHAM, *supra* note 3, at 162; Christopher Greenwood, *Self-Defence and the Conduct of International Armed Conflict*, *in* INTERNATIONAL LAW AT A TIME OF PERPLEXITY: ESSAYS IN HONOUR OF SHABTAI ROSENNE 273, 275 (Yoram Dinstein ed., 1989); SCHACHTER, *supra* note 43, at 153–54; RUYS, *supra* note 24, at 118–23; Keiichiro Okimoto, *The Relationship Between* Jus ad Bellum *and* Jus in Bello, *in* THE OXFORD HANDBOOK OF THE USE OF FORCE IN INTERNATIONAL LAW 1209, 1216 (Marc Weller ed., 2015); Sina Etezazian, *The Nature of the Self-Defence Proportionality Requirement*, 3 JOURNAL ON THE USE OF FORCE IN INTERNATIONAL LAW 260, 277–88 (2016). These factors apply to the State acting in self-defense and not to the aggressor State "for the entire use of force by the aggressor will be contrary to the principles of Article 2(4) of the UN Charter." Greenwood, *supra* note 62, at 287.

63. Greenwood, *supra* note 62, at 275–76. For Dinstein, however, when self-defense takes the form of war, its exercise can be continued until the total defeat of the adversary. DINSTEIN, *supra* note 22, at 282–83.

64. Nicaragua Judgment, *supra* note 21, ¶ 237. The temporal scope of the armed response is also a key factor to assess the necessity requirement. *See supra* Section III(A).

65. MARCO ROSCINI, INTERNATIONAL LAW AND THE PRINCIPLE OF NON-INTERVENTION. HISTORY, THEORY, AND INTERACTIONS WITH OTHER PRINCIPLES 232 (2024).

66. SCHACHTER, *supra* note 43, at 153–54; Greenwood, *supra* note 62, at 277.

67. Greenwood, *supra* note 62, at 276. The United Kingdom generally refrained from attacking military objectives on the Argentinian mainland.

Uganda's border was both disproportionate to the series of transborder attacks of which Uganda claimed to be a victim and unnecessary to exercise self-defense.[68] When the armed attack is a full-blown invasion, as in the case of Russia's ongoing "special operation" against Ukraine, however, the proportionality of self-defense reactions even far away from border areas cannot be ruled out.[69]

The targets selected for a proportionate armed response in self-defense will normally have to be military objectives: directly targeting civilians or civilian objects would not only be a violation of the principle of distinction under the *jus in bello* and a war crime, but would also likely not help to counter the military operations of the aggressor State under the law of self-defense.[70] In the *Oil Platforms* judgment, for instance, the ICJ found that the United States had to demonstrate "that . . . the [Iranian] platforms were a legitimate military target open to attack in the exercise of self-defence" because "[o]ne aspect of [necessity and proportionality] is the nature of the target of the force used avowedly in self-defence."[71] It is worth noting that, while the *jus in bello* imposes an absolute prohibition of attacking civilians and civilian objects, the law of self-defense permits exceptions if targeting a civilian object becomes essential to halting and repelling the armed attack.[72] For example, economic targets that financially support the aggressor State's war efforts may fall under this exception. Even if it were necessary to halt and repel the armed attack, however, targeting civilian objects would remain impermissible to the victim State under the *jus in bello's* principle of distinction, which is an "intransgressible principle[] of international customary law."[73]

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68. Armed Activities on the Territory of the Congo (Dem. Rep. Congo v. Uganda), Judgment, 2005 I.C.J. 168, ¶ 147 (Dec. 19) [hereinafter Armed Activities].

69. SCHACHTER, *supra* note 43, at 153–54; Greenwood, *supra* note 62, at 278. The self-defense reaction could extend to the territory of neutral States only if this is necessary and proportionate to halt and repel the armed attack. *Id.* at 277–79.

70. O'MEARA, *supra* note 36, at 85; James A. Green & Christopher P.M. Waters, *Military Targeting in the Context of Self-Defence Actions*, 84 NORDIC JOURNAL OF INTERNATIONAL LAW 3, 11–12 (2015).

71. Oil Platforms, *supra* note 56, ¶¶ 51, 74. In the discussion of necessity and proportionality, the Court subsequently found that the United States did not provide sufficient evidence of the military character of the platforms. *Id.* ¶ 76.

72. Green & Waters, *supra* note 70, at 23.

73. Nuclear Weapons Advisory Opinion, *supra* note 2, ¶¶ 78–79. The Court noted that "a use of force that is proportionate under the law of self-defence, must, in order to be lawful, also meet the requirements of the law applicable in armed conflict which comprise in particular the principles and rules of humanitarian law." *Id.* ¶ 42. On the cumulative ap-

When the armed attack comes from non-State actors, the proportionality requirement entails that the self-defense response be exclusively addressed against them and not the infrastructure of the host State, not even military infrastructure (unless of course it is also used by the armed group or the host State is responsible for the armed attack).[74] In the above mentioned *Armed Activities* judgment, the airports and towns taken by Uganda were not only far from the border with the Democratic Republic of the Congo, but the anti-Ugandan insurgents against whom the self-defense response was claimed to be directed also did not operate from there. As already seen, the ICJ found that Uganda's conduct was both unnecessary and disproportionate.[75]

The employment of certain weapons might also be a factor indicating the disproportionate character of the exercise of self-defense, particularly when it is in response to low-level armed attacks: "[a] State may not employ its more destructive weaponry if it can achieve the legitimate objectives of self-defence with the lesser weapons available to it."[76] That said, "[t]he more extensive the violence becomes, the less will be the influence that the principles of self-defence exercise in respect of the choice of weaponry."[77] Proportionality, therefore, does not in principle rule out any weapon from the victim State's options: as the ICJ found, even nuclear weapons can be used in extreme circumstances of self-defense.[78] The *jus ad bellum* and the *jus in bello* must be applied together in this context: an attack that uses a certain weapon could be proportionate under the law of armed conflict if it is not expected to cause incidental civilian damage that is excessive in relation to the concrete and direct military advantage anticipated,[79] but at the same time be disproportionate under the law of self-defense if, when considered in the context of the defensive response as a whole, the use of that weapon is not strategically required to achieve the overall purpose of defending against the

plication of proportionality under the *jus ad bellum* and the *jus in bello*, *see* Theodora Christodoulidou & Kalliopi Chainoglou, *The Principle of Proportionality from a* Jus ad Bellum *Perspective*, *in* THE OXFORD HANDBOOK OF THE USE OF FORCE IN INTERNATIONAL LAW 1187, 1193–95 (Marc Weller ed., 2015); Greenwood, *supra* note 62, at 275.

74. RUYS, *supra* note 24, at 123.

75. Armed Activities on the Territory of the Congo, *supra* note 68, ¶ 147.

76. Greenwood, *supra* note 62, at 280.

77. *Id.*

78. Nuclear Weapons Advisory Opinion, *supra* note 2, ¶¶ 42, 97.

79. *See* Protocol Additional to the Geneva Conventions of 12 August 1949, and Relating to the Protection of Victims of International Armed Conflicts, art. 51(5)(b), June 8, 1977, 1125 U.N.T.S. 3.

armed attack.[80] The reverse is also true: the use of a certain weapon might be necessary and proportionate under the law of self-defense, but prohibited under the law of armed conflict and, as a result, it could not be employed.[81]

The final factor affecting the proportionality of the self-defense response is its effects: "Proportionality evaluates whether or not the total resulting harm caused by the methods and means of defence and targeting decisions are excessive in relation to the defensive purpose and other affected interests."[82] In the *Nicaragua* judgment, for instance, the ICJ found that, "[w]hatever uncertainty may exist as to the exact scale of the aid received by the Salvadorian armed opposition from Nicaragua," the U.S. mining of Nicaraguan ports and attacks on ports, oil installations, and a naval base could not have been proportionate to that aid.[83] The effects of a self-defense response must be assessed not in relation to individual defensive operations as in the law of armed conflict, but in toto: in *Oil Platforms*, the ICJ explained that it could not "assess in isolation the proportionality of [the U.S. attacks of April 18, 1988] to the attack to which it was said to be a response; it [could not] close its eyes to the scale of the whole operation [Praying Mantis]" of which they were a part.[84] The damage to consider includes that to the target State, third States, civilians, and the natural environment.[85] Israel's operations in Lebanon against Hezbollah in 2006 and in Gaza since 2023, for instance, have been widely criticized for the significant amount of damage caused, which is hard to reconcile with the requirement of proportionality.[86] It has

80. GARDHAM, *supra* note 3, at 169; Greenwood, *supra* note 62, at 279.

81. Okimoto, *supra* note 62, at 1217. This does not mean, however, that the entire use of force in self-defense is unlawful and must be ceased only because some operations within it breached the law of armed conflict. *Id.* at 1218.

82. O'MEARA, *supra* note 36, at 166.

83. Nicaragua Judgment, *supra* note 21, ¶ 237.

84. Oil Platforms, *supra* note 56, ¶ 77.

85. Civilian harm, in particular, is the variable against which to assess the proportionality of an attack under the law of armed conflict, but it is only one of the factors to consider when assessing the proportionality of an armed attack under the law of self-defense. O'MEARA, *supra* note 36, at 160. Kreztmer notes that, unlike proportionality in the *jus in bello*, proportionality in the *jus ad bellum* also covers damage to combatants and military objectives. Kreztmer, *supra* note 24, at 278. On the harmful effects on third States and the natural environment, *see* O'MEARA, *supra* note 36, at 146–55; GARDHAM, *supra* note 3, at 173–79.

86. Enzo Cannizzaro, *Contextualising Proportionality:* Jus ad Bellum *and* Jus in Bello *in the Lebanese War*, 88 INTERNATIONAL REVIEW OF THE RED CROSS 779, 784 (2006); Raphael Van Steenberghe, *A Plea For a Right of Israel to Self-defence in Order to Restrict its Military Operations in Gaza: When Jus ad Bellum Comes to the Aid of Jus in Bello*, EJIL:TALK! (Nov. 16, 2023),

also been doubted that the complete destruction of the armed forces of the aggressor State or regime change could ever be a proportionate measure of self-defense and that the victim State could attempt to accomplish those ends without Security Council authorization.[87]

Proportionality assessments are more challenging when the armed attack consists in a series of attacks or is imminent. Ago notes:

> If . . . a State suffers a series of successive and different acts of armed attack from another State, the requirement of proportionality will certainly not mean that the victim State is not free to undertake a single armed action on a much larger scale in order to put an end to this escalating succession of attacks.[88]

In such case, the proportionality of the response must be measured against the series of attacks considered cumulatively.[89] When it comes to anticipatory self-defense against an imminent armed attack not preceded by previous attacks, assessing the proportionality of the response will require a reasonable expectation of the modalities and effects of the attack that goes beyond mere speculation.[90]

IV. AI AS AN ASSET TO ENSURE THE NECESSITY AND PROPORTIONALITY OF THE SELF-DEFENSE RESPONSE

As seen in Parts II and III, a decision to resort to self-defense involves complex *ex ante* evaluations (whether an armed attack is imminent enough, whether it will reoccur if it has ceased, how likely non-forcible means are to succeed in defending against it, whether Security Council measures will be able to maintain international peace and security, whether the modalities of

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www.ejiltalk.org/a-plea-for-a-right-of-israel-to-self-defence-in-order-to-restrict-its-military-operations-in-gaza-when-jus-ad-bellum-comes-to-the-aid-of-jus-in-bello/.

87. GARDHAM, *supra* note 3, at 167; *see also* Green, *supra* note 41, at 463. For O'Meara, however, the overthrow of a regime can be a proportionate response in self-defense "in those extreme and very rare cases where this was the only way to achieve the defensive aim." O'MEARA, *supra* note 36, at 138. For Ruys, "the more an attack or a series of attacks threaten the existence of a State, the greater the need to tackle the source of the attacks itself." RUYS, *supra* note 24, at 117.

88. Ago, *supra* note 40, at 69–70.

89. DINSTEIN, *supra* note 22, at 275.

90. As Gardham writes: "If there has been a previous attack or series of attacks or a threat of specific action, then the assessment of what is required to repel the threat is more straightforward." GARDHAM, *supra* note 3, at 179.

the response will be adequate to repel the armed attack, and whether its effects will be excessive with respect to the defensive purpose). Predictive algorithms can be an important part of the decision-maker's good faith effort to answer these questions in order to make more informed (and lawful) decisions on the resort to force in self-defense. More specifically, AI can play the following positive functions in the assessment of necessity and proportionality.[91]

As seen in Section III(A), the necessity test requires that armed force be a measure of last resort and that no peaceful alternatives are reasonably available to the victim State. AI could assist State decision-makers in establishing more confidently whether responses below the use of force threshold would be sufficient to defend against the armed attack.[92] Through machine learning and predictive algorithms, for instance, AI models can analyze historical conflict data, open-source intelligence, social media, diplomatic communications, military capabilities, and geopolitical trends to forecast whether and when a tense situation will turn into an armed attack and what its likely scale will be. Furthermore, AI can enhance strategic wargaming by generating complex, dynamic, and realistic scenarios, populating them with plausible actors and geopolitical factors, and simulating cascading effects of decisions to identify alternative paths. AI can also be employed to assess the chances of the recurrence of an armed attack in the short term. Indeed, domestic courts already use AI systems in order to establish the likelihood that an individual will re-offend in decisions to grant bail.[93] A similar system could be developed to predict the relapse of an armed attack by a State and its leaders so to assess the necessity of a self-defense reaction even if the initial armed attack has ceased.

Before resorting to self-defense, which, as said, must always remain a measure of last resort, it is generally expected that the victim State first issue a demand for the cessation of the armed attack to help avert unnecessary escalation—unless it is clear such a demand would serve no purpose or be

91. It has been noted that multiple AI systems could be used to assess the different requirements of self-defense, that is, to identify the occurrence or imminent occurrence of the armed attack and the necessity and proportionality of the response. Steiger, *supra* note 16, at 138.

92. *Id.* at 155.

93. The Correctional Offender Management Profiling for Alternative Sanctions (COMPAS), for instance, is a software used by U.S. domestic courts. SIMON CHESTERMAN, WE, THE ROBOTS? REGULATING ARTIFICIAL INTELLIGENCE AND THE LIMITS OF THE LAW 63–65 (2021). On the use of predictive algorithms in criminal justice, *see* Deeks, *supra* note 7, at 1538–47.

futile. If an AI system is allowed to make the decision to use force, therefore, it will have to incorporate this precautionary measure either by communicating with the aggressor State itself or by allowing a human operator sufficient time to do so before the response is initiated.[94] As seen in Section III(A), it is also no longer necessary to exercise the right of self-defense if the UN Security Council has taken the measures necessary to maintain international peace and security. Sufficient human control, therefore, will need to be preserved so that a human operator can interrupt the AI-enabled self-defense armed reaction if such measures are adopted by the Council and are effective in protecting the victim State.[95]

AI can also be a useful tool to assess the proportionality of the modalities of the response to an armed attack.[96] For example, AI can identify and suggest specific targets that would be most effective in stopping the attack.[97] The Israel Defense Force has used AI-based DSSs for target selection in Operation Swords of Iron against Hamas. These tools include the "Gospel" (*Habsora* in its original Hebrew name), a machine learning system based on predictive algorithms relying on geospatial and open source intelligence that automatically reviews data looking for buildings, equipment, and people thought to belong to the enemy, and, upon finding them, recommends targeting buildings and infrastructure to a human analyst who may then decide whether to pass it along to the field.[98] Other tools employed by Israel are "Lavender," an AI-powered database that identifies Palestinian men linked to Hamas or Palestinian Islamic Jihad, and "Where's Daddy?," an AI-based DSS that alerts the operator when a potential target has reached a certain location (often their home).[99] Palantir's Artificial Intelligence Platform (AIP)

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94. Bill Boothby, *AI Warfare and the Law*, 104 INTERNATIONAL LAW STUDIES 1, 77 (2025).

95. *Id.*

96. Ashley Deeks, Noam Lubell & Daragh Murray, *Machine Learning, Artificial Intelligence, and the Use of Force by States*, 10 JOURNAL OF NATIONAL SECURITY LAW AND POLICY 1, 10 (2019).

97. Steiger, *supra* note 16, at 155.

98. Omar Yousef Shehaby & Asaf Lubin, *Algorithms of War: Military AI and the War in Gaza*, ARTICLES OF WAR (Jan. 24, 2024), https://lieber.westpoint.edu/algorithms-war-military-ai-war-gaza/.

99. Yuval Abraham, *"Lavender": The AI Machine Directing Israel's Bombing Spree in Gaza*, +972 MAGAZINE (Apr. 3, 2024), www.972mag.com/lavender-ai-israeli-army-gaza/. Lavander's algorithm assesses the likelihood that individuals are members of Hamas's military wing or of the Palestinian Islamic Jihad by giving them a rating from one to one hundred.

has also played a significant role in Ukraine's defense against Russia's invasion by processing data from satellites, drones, and ground reports to create real-time maps of Russian troop movements, artillery positions, and supply lines. The platform can flag threats, suggest different courses of action, and assess the availability of necessary resources, thus enhancing and speeding up decision-making.[100] AIP is closely linked to MetaConstellation, an AI-powered Palantir system providing real-time data from a network of commercial satellites that are then analyzed and operationalized by AIP.[101]

In relation to the choice of weapons, it should be recalled that, in the *Nuclear Weapons* Advisory Opinion, the ICJ appears to distinguish two types of self-defense: that against an "ordinary" armed attack and that against an armed attack that threatens the very survival of the victim State.[102] Only in the latter case can nuclear weapons potentially be a permissible means of self-defense.[103] Assuming that this distinction has a basis in customary international law, an AI system will need to be able to assess whether the survival of a State is at stake before ever using, or recommending the use of, nuclear weapons.

AI can additionally play an important role in ensuring the proportionality of the self-defense response by forecasting the effects of the resort to the defensive force. The use of AI-enhanced wargaming has already been mentioned and could be employed to model probabilistic outcomes of kinetic or cyber operations, particularly in populated areas, using simulated real-time data. Automated Damage Assessment tools relying on machine learning and computer vision can also analyze damage levels to help determine the proportionality of an armed response in self-defense.[104] Deep Learning-Based Impact Simulations are AI models that combine deep learning techniques with simulation models and that can be used to predict blast radius, civilian casualties, and infrastructure damage from different weapons, while Crowdsourced Damage Assessment combines human input with machine

100. Neil Renic, *Tragic Reflection, Political Wisdom, and the Future of Algorithmic War*, 78 AUSTRALIAN JOURNAL OF INTERNATIONAL AFFAIRS 247, 247–48 (2024). On Ukraine's resort to AI in the conflict with Russia, *see* Kateryna Bondar, *Understanding the Military AI Ecosystem of Ukraine*, CENTER FOR STRATEGIC AND INTERNATIONAL STUDIES (Nov. 12, 2024), www.csis.org/analysis/understanding-military-ai-ecosystem-ukraine.

101. Bruno Maçães, *How Palantir is Shaping the Future of Warfare*, TIME (July 10, 2023), https://time.com/6293398/palantir-future-of-warfare-ukraine.

102. Nuclear Weapons Advisory Opinion, *supra* note 2, ¶ 96.

103. *Id.* ¶ 97.

104. Computer Vision is a field of AI that enables computers to interpret and make decisions based on visual data.

learning to analyze social media, satellite images, and drone footage and verify civilian casualties post-strike. Other useful AI applications in this context are Data Fusion AI, which can integrate satellite imagery, intercepted communications, and battlefield reports to assess the proportionality of ongoing military operations, and Real-Time Civilian Density Mapping, which uses AI to predict population movements and concentration in conflict zones to minimize harm.[105]

It is worth recalling that, as the ICJ found, "[r]espect for the environment is one of the elements that go to assessing whether an action [in self-defense] is in conformity with the principles of necessity and proportionality."[106] AI can be used to estimate the environmental damage caused by a response to an armed attack, and thus its proportionality, by analyzing large datasets from various sources like satellite imagery, sensor networks, and climate models, allowing for the detection and quantification of changes in ecosystems, such as deforestation, pollution levels, coastal erosion, and biodiversity loss. By analyzing data from various sources, AI has the potential to provide more accurate and comprehensive assessments of the environmental impact of military operations than traditional methods.

Finally, some features of AI can be helpful to determine both the necessity and the proportionality of a self-defense response. AI's ability to process larger amounts of data much quicker than human beings offers not only enhanced threat detection and improved damage estimation but also faster decision-making, which allows swift adjustments to changing battlefield conditions. Faster decision-making is particularly important in dynamic environments where the armed attack occurs at high speed (as in the case of cyber attacks) and a decision on whether to react and how might need to be made in a very short time.[107] AI systems could also take or recommend decisions made on more objective assessments than those of humans, thus minimizing the influence of emotions or misjudgments.[108]

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105. Meheret Takele Mandefro, *Mapping Vulnerable Populations with AI (ICRC)*, UNITED KINGDOM HUMANITARIAN INNOVATION HUB (May 28, 2025), https://www.ukhih.org/news/mapping-vulnerable-populations-with-ai-icrc/.

106. Nuclear Weapons Advisory Opinion, *supra* note 2, ¶ 30.

107. Peter Margulies, *Autonomous Cyber Capabilities Below and Above the Use of Force Threshold: Balancing Proportionality and the Need for Speed*, 96 INTERNATIONAL LAW STUDIES 394, 416 (2020).

108. It has been observed that "[h]uman decision makers are prideful and vengeful; they misinterpret and miscalculate; they overreact and sometimes underreact." Renic, *supra* note 100, at 250.

V. RISKS AND CHALLENGES IN THE USE OF AI TO DETERMINE NECESSITY AND PROPORTIONALITY OF A SELF-DEFENSE RESPONSE

That said, relying on AI systems to ensure the necessity and proportionality of an armed response in self-defense also introduces several risks and challenges. The first and perhaps main challenge is that of translating "contested and malleable concepts such as necessity and proportionality into discrete, binary decision trees."[109] As has been seen, necessity requires that no other options to defend against the armed attack are reasonably available to the victim State. It is not clear whether an abstract and highly context-dependent notion like that of reasonableness can be turned into computer code. Indeed, although they can detect objects in a technical sense, AI systems are unable to understand the meaning of concepts and to perform abstract reasoning, a limitation known as "semantic gap"; they can only make basic associations between an object and its context.[110] In regard to proportionality, it is unclear whether algorithms would be able to compare and balance different values like the need to repel an armed attack on the one hand and the modalities and effects of the armed reaction on the other.[111] As has been observed, "algorithmic systems that attempt to replicate the proportionality weighing exercise are not fit for purpose, failing to capture the necessary contextual, qualitative and value-laden nature of proportionality assessments."[112] All in all, unlike speed limits, the law of self-defense is not a binary rule. It is not only about crossing quantifiable thresholds but also about abstract and highly contextual notions like reasonableness and excessiveness that remain problematic for encoding.[113]

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109. Deeks, Lubell & Murray, *supra* note 96, at 14; *see also* Ashley Deeks, *Coding the Law of Armed Conflict*, *in* THE FUTURE OF ARMED CONFLICT 41, 53 (Matthew C. Waxman & Thomas W. Oakley eds., 2022).

110. INT'L COMM. OF THE RED CROSS, AUTONOMY, ARTIFICIAL INTELLIGENCE AND ROBOTICS: TECHNICAL ASPECTS OF HUMAN CONTROL 20 (Aug. 20, 2019). The conclusion is that "[r]easonableness is . . . not a matter of computation or creating artificial boundaries of reasonable conduct." Taylor Kate Woodcock, *Human/Machine(-Learning) Interactions, Human Agency and the International Humanitarian Law Proportionality Standard*, 38 GLOBAL SOCIETY 100, 110 (2024).

111. This challenge will be less significant if one adopts the quantitative notion of proportionality described in Section III(B) of this article.

112. Woodcock, *supra* note 110, at 115.

113. ICRC & GENEVA ACADEMY, *supra* note 9, at 15.

Second, while it is true that an AI system will not be affected by human emotions, this is not necessarily always an advantage. Indeed, subjective decisions based on a person's experience and empathic skills might produce more reasonable and ethically sound assessments than those merely based on correlations and statistics, particularly when it comes to decisions on the use of armed force and its necessity and proportionality. AI "could contribute to inadvertent, and potentially catastrophic, escalations in the resort to force in scenarios where human decision makers would have exercised restraint."[114] The cautionary tale of the officer on a Soviet submarine who refused to authorize the launch of a nuclear-armed torpedo during the 1962 Cuban missile crisis is well known. While American depth charges were exploding near the submarine, he remained (rightly, as it turned out) unconvinced that this was conclusive evidence that a war between the United States and the USSR had broken out and overruled the submarine commander's decision to press the button.[115] One can wonder whether AI would have taken, or recommended, the same cautious (and ultimately sensible) decision.

Third, whilst AI can enhance threat detection, it might also lead to misidentifying threats and generating hallucinations and false positives, resulting in an unnecessary and/or disproportionate resort to force in self-defense. AI-driven early warning systems, for instance, could misinterpret unusual cyber activity in the cyber infrastructure of an unfriendly State as an impending armed attack, triggering a forcible reaction prematurely. It also seems that Lavander generated false positives in 10 percent of the cases during the test phase and was deployed with limited human supervision.[116] The problem is that predictive AI systems require a significant amount of accurate, real-time data to work dependably: the more (accurate) data fed to the algorithm, the more reliable the outputs.[117] Unlike in AI tools used to prevent crime at the domestic level, however, it is doubtful that sufficient relevant, complete, and accurate data and precedents are presently available in relation to the exercise

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114. Toni Erskine & Steven E. Miller, *AI and the Decision to Go to War: Future Risks and Opportunities*, 78 AUSTRALIAN JOURNAL OF INTERNATIONAL AFFAIRS 135, 139 (2024).

115. Nathan Leys, *Autonomous Weapon Systems, International Crises, and Anticipatory Self-Defense*, 45 YALE JOURNAL OF INTERNATIONAL LAW 377, 377–78 (2020).

116. Daniele Amoroso, *Sistemi di supporto alle decisioni basati sull'IA e crimini di guerra: alcune riflessioni alla luce di una recente inchiesta giornalistica*, 18 DIRITTI UMANI E DIRITTO INTERNAZIONALE 347, 355–57 (2024).

117. Deeks, Lubell & Murray, *supra* note 96, at 13. As has been noted, "it is essential that data be representative of the reality where the system is intended to operate to avert unexpected bias or serious flaws in the system's functioning." Vestner & Rossi, *supra* note 11, at 539.

of the right of self-defense by States so as to reduce the chances of errors and miscalculations. Indeed, only a relatively small number of armed attacks have occurred since 1945 and "[t]he circumstances in which states use force are so vastly diverse that comparisons across examples may be irrelevant."[118] Miscalculations could occur not only because of insufficient or poor-quality data, but also as a result of "data poisoning,"[119] human bias transferred to the AI system during the development stage,[120] and cyber attacks. An AI system, for instance, could be deceived into believing that an armed attack is coming from a State by using IP spoofing, botnets, or deepfakes.[121] Machine learning is especially susceptible to adversarial attacks employing manipulation and deception.[122]

Fourth, resort to AI may risk broadening the situations in which the use of force in self-defense is permissible by bringing in a "[t]emporal repositioning of the necessity requirement."[123] Indeed, the use of predictive algorithms allows the identification of risks before they become actual threats.[124] Certain commentators have thus suggested that if AI systems are better than humans at predicting the future, then the concept of imminence and of anticipatory self-defense should be revised and expanded, taking this new capability into account.[125] Assume, for instance, that AI has estimated that a certain head of State, because of their psychological profile, erratic behavior, past history, and the military capabilities they control, will sooner or later launch an armed attack against a neighboring country. The argument could be made that some act of self-defense to oust them from power and thus prevent the armed attack before it materializes can be conducted as long as

118. Deeks, Lubell & Murray, *supra* note 96, at 12.

119. Gary P. Corn & Eric Talbot Jensen, *"Attacking" Big Data: Strategic Competition, the Race for AI, and the International Law of Cyber Sabotage*, *in* BIG DATA AND ARMED CONFLICT: LEGAL ISSUES ABOVE AND BELOW THE ARMED CONFLICT THRESHOLD 91, 94 (Laura A. Dickinson & Edward W. Berg eds., 2024).

120. Robin Geiß & Henning Lahmann, *The Use of AI in Military Contexts: Opportunities and Regulatory Challenges*, 59 THE MILITARY LAW AND LAW OF WAR REVIEW 165, 179–80 (2021).

121. Deeks, Lubell & Murray, *supra* note 96, at 11.

122. Int'l Comm. of the Red Cross, *Artificial Intelligence and Machine Learning in Armed Conflict: A Human Centred Approach*, 102 INTERNATIONAL REVIEW OF THE RED CROSS 463, 477 (2020).

123. Francis Grimal & Michael J. Pollard, *Embodied Artificial Intelligence and* Jus ad Bellum *Necessity: Influence and Imminence in the Digital Age*, 53 GEORGETOWN JOURNAL OF INTERNATIONAL LAW 209, 248 (2022).

124. Renic, *supra* note 100, at 251.

125. Grimal & Pollard, *supra* note 123, at 261.

the course of events has been deemed inevitable.[126] This would minimize (or even avoid) civilian harm resulting from an armed conflict. For "if all the 'moves' have been considered, and all the potential outcomes are known, pre-emption should be permitted in the Machiavellian sense—in that it is for the greater good."[127]

Even leaving aside the unresolved controversy about the admissibility of anticipatory self-defense,[128] the problem with this argument is that it mistakes statistical probability with certainty and does not consider that, unlike in a game of chess where the number of participants is limited and moves and counter-moves are restricted, in a real geopolitical scenario there are an infinite number of variables.[129] In other words, "statistical, data-driven methods could encourage states (and other resort-to-force decision makers) to take as a 'given' what are no more than forecasts of possible future scenarios."[130] At the end of the day, certainty about the future is and remains an illusion with or without AI: to paraphrase Philip K. Dick, the risk is to allow reactions in self-defense against an aggressor that has not breached Article 2(4).[131] AI can be useful by prospecting *possible* futures to the decision-maker, but cannot anticipate with sufficient certainty the *single* future that will materialize.

Be that as it may, even if AI systems were capable of establishing that an armed attack would inevitably be carried out by a certain State at some more or less distant point in the future, what would also need to be demonstrated from a necessity perspective is that other non-forcible means to avert it were not reasonably available: "the longer the period between the anticipated armed attack and the response, the more pressure there will be on the potential victim state to resolve the matter peacefully, rather than resorting to military force."[132]

The above risks and challenges present themselves not only if it is the AI system that makes the decision to resort to self-defense, but also when it

126. *Id.* at 242.

127. *Id.*

128. *See supra* Part III, para. 2.

129. Indeed, an algorithm would need not only to consider "obvious matters such as troop movements or weapons stockpiling, but also factors such as political dynamics between and within states, economic interests, and human psychology." Deeks, Lubell & Murray, *supra* note 96, at 13.

130. Erskine, *supra* note 5, at 183.

131. In *Minority Report*, John Anderton describes "precrime methodology" as "taking in individuals who have broken no law." PHILIP K. DICK, MINORITY REPORT 2–3 (2002).

132. O'MEARA, *supra* note 36, at 67.

is used as a DSS. Indeed, the huge quantity of data analyzed by AI, the limited time to verify them, and automation bias, that is, human deference to AI-based recommendations, can turn the human decision-maker into "a rubber stamp."[133] While it is undeniable that faster decision-making is a considerable advantage in today's warfare, this "ideology of acceleration" is not without risks, as "speed is not an unalloyed good; it is a contingent one. It is not an end to be sought in itself; it is a means to an end."[134] These challenges are further exacerbated by the fact that AI systems operate as a "black box" and decisions based on them are difficult to review because of the opacity of the process.[135] All this seems at odds with the ICJ's finding that "the requirement of international law that measures taken avowedly in self-defense must have been necessary for that purpose is strict and objective, leaving no room for any 'measure of discretion.'"[136] The problem is even more serious in the case of machine learning, where the system might make recommendations or decisions on the basis of new data in a manner unpredictable to the human programmers. Transparency and explainability are therefore essential. The U.S. Department of Defense Directive 3000.9 on Autonomy in Weapon Systems, for instance, requires that AI be designed with "technologies and data sources that are transparent to, auditable by, and explainable by relevant personnel."[137] It would arguably not be sufficient that an AI system limits itself to suggest that there is a 90 percent likelihood that an armed attack will occur. At a minimum, the system will need to indicate on what grounds such conclusion was reached.[138]

VI. CONCLUSIONS

This article has argued that AI has the potential to enhance necessity and proportionality assessments when States exercise their right to self-defense against an armed attack. In particular, it can be a tool that improves decisions by making processes more efficient and faster, which is particularly valuable in today's volatile conflict scenarios. AI can evaluate real-time intelligence

133. Abraham, *supra* note 99. It has been noted that AI-based DSS can become de facto AWSs "where the hierarchy between the human operator and AI-DSS is flipped, with the operator exercising only nominal oversight over outputs and passively approving system recommendations." BLANCHARD & BRUUN, *supra* note 17, at 10.

134. Renic, *supra* note 100, at 253.

135. Erskine, *supra* note 5, at 184; Deeks, *supra* note 7, at 1568.

136. Oil Platforms, *supra* note 56, ¶ 73.

137. U.S. DOD DIRECTIVE 3000.09, *supra* note 16, at 4.

138. Deeks, Lubell & Murray, *supra* note 96, at 20–21.

for enhanced threat detection, target and weapon selection, and damage estimation in ways that would otherwise be unattainable to humans. As the victim State must assess necessity and proportionality on the basis of all information reasonably available at the time of the response, AI could raise the bar of this due diligence standard, as more information to base the decision on will be available thanks to its use.

At the same time, however, AI presents significant risks and challenges. The most significant problem is that, from a technical perspective, it is still not clear whether flexible notions like reasonableness and excessiveness, which are at the core of necessity and proportionality assessments, can effectively be translated into computer code. Second, the decreased role of human agency in the decision-making process might produce less reasonable and less ethically sound necessity and proportionality assessments. Third, whilst it is true that AI can enhance threat detection, it might also lead to misidentifying threats and generating hallucinations, resulting in unnecessary and/or disproportionate uses of force in self-defense. Fourth, resorting to AI might risk broadening the situations in which the use of force in self-defense is claimed to be permissible by expanding its temporal window on the basis of what remains no more than an educated guess of the AI system that an armed attack will occur.

All in all, there is a need for human oversight, clear legal frameworks, and robust ethical guidelines to ensure that AI does not undermine fundamental legal principles. Humans, in particular, must remain responsible for the development and deployment of AI capabilities when it comes to high-risk decisions like those involving the use of armed force in self-defense. If AI is allowed to make the decision itself, a human must remain able to interrupt AI-enabled actions when, for instance, errors are detected, means short of the use of force become a feasible alternative, or measures to maintain international peace and security are adopted by the UN Security Council. Alternatively, AI could be used only as a DSS that assists human operators rather than replaces them. Even in this case, however, safety protocols should be established and speed limitations should remain in place to maintain human judgment and control over decisions involving the use of armed force.[139] Appropriate training of those relying on AI at any level of the

139. The UN General Assembly has stressed "the need for States to implement appropriate safeguards, including measures that relate to human judgment and control over the use of force, in order to ensure responsible application of artificial intelligence in the military domain consistent with their respective obligations under applicable international law." G.A. Res. 79/239, pmbl. (Dec. 31, 2024).

decision-making process is also of fundamental importance to ensure that there are no deviations from the relevant rules.[140]

140. ICRC & GENEVA ACADEMY, *supra* note 9, at 20.