The Challenge of Lethal Autonomous Weapons Systems (LAWS)

by William Bunn
Graduate Program in International Studies, Old Dominion University

Introduction

On a cool desert morning, two aircraft appeared on the horizon, though their small size and low-observational (or stealth) characteristics made them difficult to pick out against the blue sky. With their trapezoidal shape, stub wings, and lack of tails, the craft looked more like something out of a science fiction movie than a modern battlefield. As "unmanned combat air vehicles" (UCAVs), these platforms were less than half the size of a typical manned fighter aircraft. More importantly, as the aircraft approached enemy territory, they began to "work as a team to accomplish their mission via leveraging a set of algorithms, onboard sensors and communications data links...(utilizing) autonomous control and decision making largely their own."[1]

Suddenly, a...threat radar activated. The pair of networked UCAVs immediately classified the threat and executed a plan to destroy it based on the position of each (aircraft) in relation to the target, what weapons were available, what each drone's fuel load was and the nature of the target itself. The calculations happened in the blink of an eye. One...immediately changed heading to attack the...(surface to air missile) site while asking permission to do so from the ground operator monitoring the mission. The attack was approved, and the (UCAV) obliterated the...threat with GPS-guided bombs. Then, another threat – one tougher to detect than the first – popped up and was successfully prosecuted with great prejudice by the flying robotic duo.[2]

X-45A experimental U.S. unmanned combat air vehicles made by Boeing. Each X-45A is over 26 long, wingspan of 34 feet, and weighs 8,000 lbs empty.

The attack described above did not take place over a desert in the Middle East, but in a desert in California, near Edwards Air Force Base. The aircraft were Boeing X-45A technology demonstrators targeting simulated enemy missile sites. And the year was 2005. Even a decade and a half ago, two years before the launch of the iPhone, the concept of a "lethal autonomous weapons system" (LAWS) had moved beyond science fiction and into science fact. Since 2005 miniaturization, computing power and processing speeds have all increased by an order of magnitude, and as such there has been a corresponding explosion in unmanned military technological improvements.

---

[1] Tyler Rogoway, "The Alarming Case Of The USAF's Mysteriously Missing Unmanned Combat Air Vehicles," The Drive, 9 June 2016, https://www.thedrive.com/the-war-zone/3889/the-alarming-case-of-the-usafs-mysteriously-missing-unmanned-combat-air-vehicles

[2] Ibid.

Defining lethal autonomous weapons systems

Developing a definition for a complete lethal autonomous weapon system (LAWS) is arguably one of the major stumbling blocks to developing an effective international response to the emergence of increasingly autonomous military technology, whether regulation or a developmental ban.[3]

Around 800 AD, gunpowder was invented in China, changing forever how warfare was waged, and beginning what is considered the first revolution in weapon development. In July of 1945, the United States began the second revolution with the successful splitting of the atom in the desert of New Mexico. If deployed, the Lethal Autonomous Weapon System (LAWS), known colloquially as "killer robots," would mark the third revolution in weapon development, as they will permit armed conflict to be fought at a scale greater than ever, and at timescales faster than humans can comprehend.[4]

Even so, more than a half decade after the United Nations took up the issue, there remains no agreed upon definition on just what a LAWS is (nor, for that matter, is there a UN-agreed upon definition of "Artificial Intelligence"). In his article *So Just What Is a Killer Robot? Detailing the Ongoing Debate around Defining Lethal Autonomous Weapon Systems*, Dr. Austin Wyatt concisely outlines the multitude of definitional approaches taken by different stakeholders in the debate. Unlike the expanding of a gas or the splitting of an atom, the idea of "autonomy" is far from a binary discussion. As such, the international community is struggling

with how to ban (or regulate) weapons which lie on what Wyatt calls a "function-based spectrum where human interaction remains present at some point."[5]

The non-governmental organization (NGO) "PAX" (paxforpeace.nl) articulates this concept in its publication *Where to draw the line: Increasing Autonomy in Weapon Systems – Technology and Trends:*

Since we see lethal autonomous weapons developing within a continuum, with levels of technology varying from simple automation towards full autonomy, and in different functionalities of weapon systems, we also witness a slippery slope where the human role is gradually diminishing in the decision making loop. Therefore PaX believes that it is imperative that states draw a clear line, guaranteeing meaningful human control over decisions of the use of force.[6]

It is not enough to think about LAWS as simply weapons that can kill apart from explicit direction from a human. Otherwise, anti-personnel landmines and booby traps would be included. A landmine, by this reckoning, is fully autonomous: it cannot differentiate between friend or foe, soldier or civilian. Once deployed, the only requirement for activation is a certain amount of pounds per square inch pressed upon the pressure plate. Unlike the X-45A, the mine does not radio back to base for permission to engage. It should be no surprise, then, that many of the arguments for the banning of LAWS are ones that were used to successfully pass a ban on land mines in 1997 (it also instructional to note that neither China, the U.S., nor Russia are

---

[3] Austin Wyatt, "So Just What Is a Killer Robot?: Detailing the Ongoing Debate around Defining Lethal Autonomous Weapon Systems," Washington Headquarters Services, 8 June 2020, https://www.whs.mil/News/News-Display/Article/2210967/so-just-what-is-a-killer-robot-detailing-the-ongoing-debate-around-defining-let/

[4] "An Open Letter to the United Nations Convention on Certain Conventional Weapons," Future of Life

Institute, 11 January 2019, https://futureoflife.org/autonomous-weapons-open-letter-2017/

[5] Wyatt.

[6] Frank Slijper, "Where to Draw the Line," PAX, April 2018, https://www.paxforpeace.nl/publications/all-publications/where-to-draw-the-line p. 7.

signatories to that agreement). Therefore, definitions of LAWS must be more specific than simple autonomy.

China definition: In 2018, many were shocked when China became the first permanent member of the U.N. Security Council (and a country actively working to incorporate AI into military applications) to call for a ban on the use of LAWS. While initially greeted with enthusiasm, it soon became clear that the PRC was seizing on the lack of an internationally agreed upon definition to control the debate in its favor. The Chinese definition was centered around five

characteristics that set a very high bar for what could be considered LAWS. For example, it included "an unusually high autonomy barrier, stating that a LAWS would have an 'absence of human intervention and control' for the 'entire process of executing a task.'"[7] In other words, China appeared to be favoring a ban on a type of weapon it had no intention of building. The ploy was akin to announcing they were in favor of banning all tanks, but then defining tanks as "armored vehicles that can travel the speed of light." The announcement sounded good, but had no practical benefit.

---
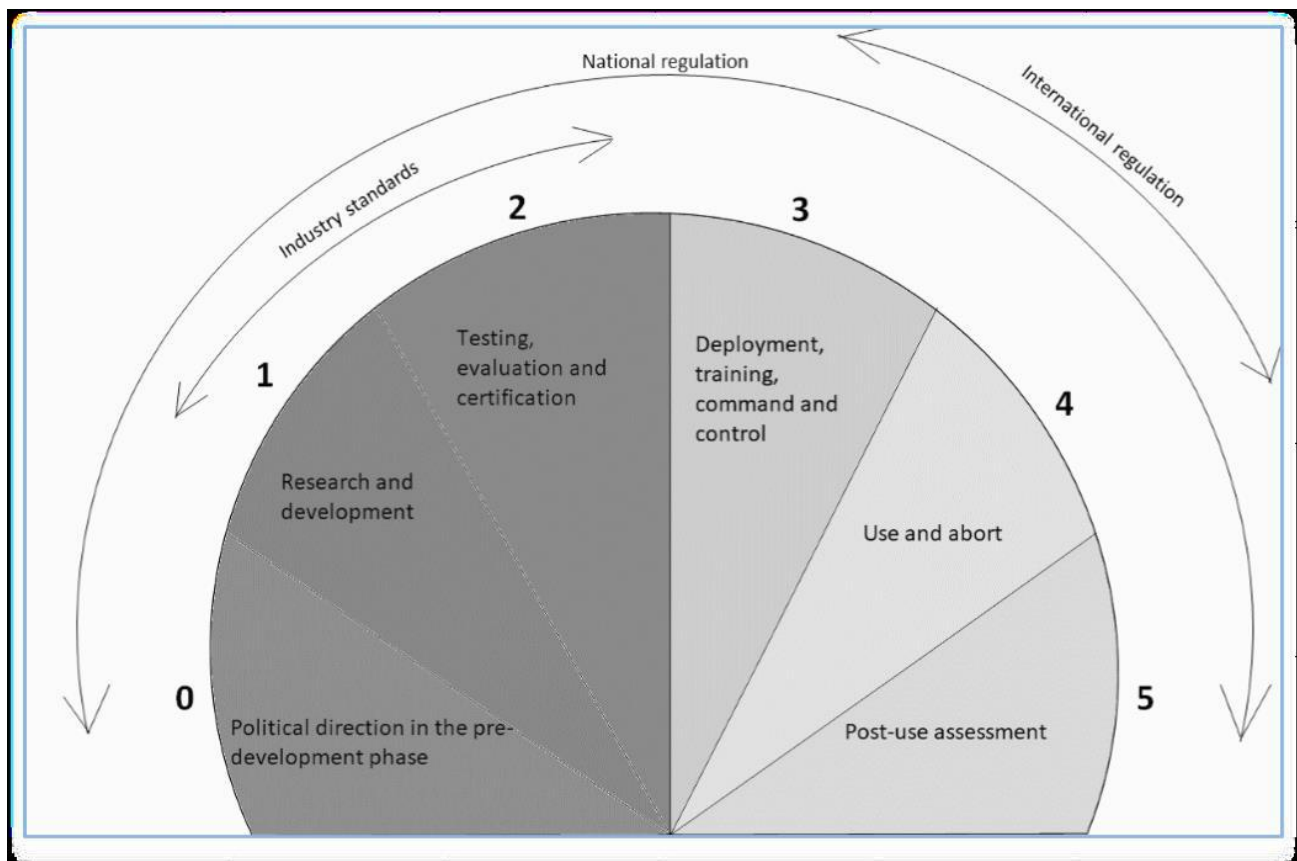
[7] Ibid.

United States Department of Defense definition: To find a starting point for a working definition, many groups turned to the U.S. Department of Defense, which in 2012 published a directive that provided such a statement. In the DoD Directive 3000.09, the U.S. "defines a weapon as fully autonomous if, when activated, it 'can select and engage targets without further intervention by a human operator.'" In the 2005 test of the X-45As (detailed at the beginning of the paper), once the UCAVs detected and determined a targeting solution for the notional enemy radar, it "radioed back" to a human operator for permission to engage; however, this was not a necessary step from a technological point of view (indeed, it was more difficult to request permission than it would have been to simply engage the target once identified). Thus, according to the DoD definition, the technology has existed for the deployment of fully autonomous weapons systems for some time.

Proposed NGO definitions

There are a multitude of non-governmental organizations (NGOs) that have become actively involved in the debate over LAWS, and have participated in the UN discussions that have taken place in Geneva since 2013. Some of the NGOs are umbrella organizations that have been established for the purpose of banning or regulating LAWS (or "killer robots," as they are called by many of these groups). While their definitions vary to one degree or another, they all share similar characteristics; as such, Dr. Wyatt uses as an example the definition put forward by a member of the Campaign to Stop Killer Robots (CSKR):

Killer robots are fully autonomous weapon systems. These are weapons that operate without meaningful human control, meaning that the weapon itself can take decisions about where and how it is used; what or whom it is used against; and the effects of use.[8]

One of the key phrases in this (and most other NGO definitions) is the term *meaningful human control*, which has become a key talking point at UN discussions on the subject. "The Campaign to Stop Killer Robots, and affiliated groups, have enthusiastically embraced Meaningful Human Control as a vital standard that, employed alongside a ban on fully autonomous weapons, would arguably prevent the transfer of the decision to use lethal force to those robotic systems that are not prohibited."[9] Although the definition of "meaningful" is open to interpretation, this definition would ensure that machines would not be capable of making life-or-death decisions over humans. This is one of the key arguments put forth by those calling for a ban on LAWS: that it would be a violation of human rights to put robots in ultimate control of life-and-death decisions.

An early autonomous weapon system, the US Phalanx close-in weapon system, used mostly for defense of ships against missile attacks. First operation in 1980

In *Lethal Autonomous Weapon Systems under International Humanitarian Law*, Kjølv Egeland introduces another key aspect into any definition of LAWS, that of *causality*:

---

[8] Ibid.

[9] Ibid.

Supposedly, LAWS would have the ability to make decisions themselves, thus breaking the causal chain between humans and the use of force. This could viably be understood as the defining legal aspect of autonomous weapon systems. A weapon system is autonomous if its initiation and use of force – i.e. firing of a weapon – cannot reasonably be traced back to one or a small group of human beings. Geoffrey S. Corn captures this point when he states that LAWS are "weapons with the capacity to utilize artificial intelligence to replicate human cognitive reasoning."[10]

Introducing AI and the idea of decision-making by the weapon system would obviously eliminate such weapons as landmines (as well as self-defense weapons in automatic mode such as the Vulcan Phalanx Close-in Weapons System).

Serbian Land Rover towing trailer with *Miloš* tracked combat robot

UN Actions Through 2017

The UN took up the issue of Lethal Autonomous Weapons Systems in 2013, with an Informal Meeting of Experts during the Convention on Prohibitions or Restrictions on the Use of Certain Conventional Weapons Which May Be Deemed to Be Excessively Injurious or to Have Indiscriminate Effects (the CCW). The CCW had already been expanded to include protocols restricting Non-Detectable Fragments, Mines, Incendiary Weapons, Blinding Weapons, and Explosive Remnants of War.[11]

After two years of informal discussions, the decision was made in 2016 to elevate the issue through the establishment of a formal "Group of Government Experts" (GGE), which held its first meeting in Geneva from 13-17 November 2017. A "food for thought" paper was submitted by the chairperson to frame the meeting with 27 questions that needed to be addressed under three broad categories: technology, military effects, and legal/ethical issues.[12] These categories have been observed in the meetings held since 2017.

While there is benefits from the cross-stakeholder discussion that is inherent in the CCW, the requirement for consensus among groups with such divergent positions also poses challenges. The "Chair's summary of the discussion" in 2017 highlighted as many areas of disagreement as agreement. Recalling the lack of an agreed-upon definition of LAWS, the chair noted that "While some delegations expressed the view that fully autonomous weapon systems did not yet exist, others pointed to the existence of precursor technologies as well as the

---

[10] Kjølv Egeland, "Lethal Autonomous Weapon Systems under International Humanitarian Law," *Nordic Journal of International Law* 85, no. 2 (2016): pp. 89-118, https://doi.org/10.1163/15718107-08502001 p. 94.
[11] Amandeep S. Gill, "The Role of the United Nations in Addressing Emerging Technologies in the Area of Lethal Autonomous Weapons Systems," *UN*

Chronicle 55, no. 4 (2019): pp. 15-17, https://doi.org/10.18356/87196c84-en
[12] Amandeep Singh Gill, *Food-for-Thought Paper: Group of Governmental Experts of the States Parties to the Convention on Prohibitions or Restrictions on the Use of Certain Conventional Weapons Which May Be Deemed to Be Excessively Injurious or to Have Indiscriminate Effects, Geneva, 13-17 November 2017: Item 6* (Geneva, CH: UN, 2017).

deployment by some States of increasingly autonomous technologies."[13]

Perhaps not surprisingly, there was no consensus as to what should be ultimately done about LAWS:

Delegations expressed preferences for a range of policy options, including a legally-binding instrument, which could preventively prohibit LAWS. This prohibition could take the form of a CCW protocol. The need for an immediate moratorium on the deployment of LAWS pending agreement on a prohibition was mentioned in this regard. Other policy options proposed included a politically-binding declaration and a future Code of Conduct. Equally, the view that consideration of policy options was premature at this stage was emphasized.[14]

Still, agreement was reached on a number of issues: first, that the CCW was the appropriate forum for dealing with the issue of LAWS, and thus would continue as the primary United Nations framework moving forward. Second, that "Responsibility for the deployment of any weapons system in armed conflict remain with the States."[15] Perhaps most importantly, the GGE determined that "International Humanitarian Law (IHL) continues to apply fully to all weapons systems, including the potential development and use of lethal autonomous weapons systems."[16]

LAWS and International Humanitarian Law (IHL)

Since the UN has determined that LAWS must comport to existing International Humanitarian Law's restrictions on the employment of force, a basic understanding on IHL is necessary prior to

continuing with a look at actions by the UN. There are three pillars that IHL rests upon: discrimination, proportionality, and precaution; a fourth requirement is to avoid inflicting "unnecessary suffering" in the conduct of combat operations.

Discrimination: Looking at the first pillar, any employment of force must be able to discriminate between civilians and combatants (or between combatants and non-combatants, such as soldiers trying to surrender). In the post-9/11 era, where terrorists specifically attempt to blend into the civilian population in order to exploit the protections afforded to them, discrimination has become difficult even apart from LAWS considerations. If a target is a specific human, facial recognition software could become a rapidly advancing technology that could aid LAWS in the future. However, a report published during the 15th International Symposium on Applied Machine Intelligence and Informatics by the Institute of Electrical and Electronics Engineers (IEEE) poked holes in the idea that computer facial recognition is as far along as the public believes. "Even though deep neural networks now achieve such admirable results, the best currently available models can still make errors, some of which are quite astonishing…the model misclassifies them with high confidence."[17] In other words, when the computer misidentified something, it thought with a high degree of certainty that it was not wrong.

Even if such technological challenges as described above are overcome, those opposed to the introduction of LAWS on the battlefield believe that robots would not have the ability to make intuitive judgement calls on discernment,

---

[13] *Report of the 2017 Group of Governmental Experts on Lethal Autonomous Weapons Systems (LAWS)* (Geneva, CH: UN, 2017), 7.
[14] Ibid, 8.
[15] Ibid, 4.
[16] Ibid.

[17] Vojtech Simak et al., "Why Lethal Autonomous Weapon Systems Are Unacceptable ," IEEE 15th International Symposium on Applied Machine Intelligence and Informatics (IEEE, January 2017), https://www.researchgate.net/publication/315865048_Why_Lethal_autonomous_weapon_systems_are_unacceptable p. 361.

at least not to the degree they can be trusted to operate without a "man in the loop":

The technology available today is by all accounts far away from a scenario in which robots would be capable of engaging legitimate targets and not civilians, with or without uniformed enemies. According to the roboticist and anti-LAWS campaigner Noel Sharkey, LAWS would not only have to attain the sensory or vision processing capacity to distinguish between civilians and combatants, but would have to overcome severe limitations in programming language and operationalizing "common sense."[18]

Proportionality: While under IHL civilians may never be intentionally targeted, it is expected in wartime that some "collateral damage" to civilians and civilian infrastructure will occur. That is where the principle of proportionality comes in, however. This "restricts the amount and kind of force that can be used in a conflict such that it does not create excessive injuries and death of civilians and damage to civilian objects with respect to the direct anticipated military advantage."[19] This may be even more problematic for LAWS, as the concept involves assessing a complex and ever-changing environment (which automated systems would be good at) and applying common sense and judgement calls to determine how much force ought to be used (which automated systems are thus far not good at).

Precaution: The final principle of IHL "states that parties involved in a conflict must take all feasible precautions to protect civilian population and objects under their control against the effect of attacks."[20] The actual phrasing in the United Nation's "Additional Protocol I" uses the term *constant care*. This strikes at the heart of the issue when it comes to the ability for LAWS to comport to IHL: can

autonomous systems, without human communication, ensure this constant care to spare civilians is taken? Does this requirement even make sense when applied to machines (no matter how advanced those machines are)?

The Martens Clause and Humanity: The preceding three pillars of IHL, while posing serious challenges to the legal deployment of LAWS, could be overcome by technology (indeed, with the pace of advancement in the areas of Artificial Intelligence and Machine Learning, such a future is not unimaginable). However, Egeland argues that there is one hurdle that LAWS could never overcome: the notion that International Humanitarian Law "presupposes responsible human agency."[21] In framing this argument, he (and many NGOs) quote a section of the Additional Protocol I known as the "Martens Clause," which states:

In cases not covered by this Protocol or by other international agreements, civilians and combatants remain under the protection and authority of the principles of international law derived from established custom, from the principles of humanity and from the dictates of public conscience."[22]

The position here is that machines can never be programmed with something as ill-defined as "principles of humanity," nor are they able to develop a "public conscience" – as such, LAWS could never be utilized in accordance with IHL. Indeed, this argument falls more in the realm of morality than of law; if machines are allowed to make the decision on the killing of a human being, then the principle of human dignity (discussed in the Universal Declaration of Human Rights) is violated. As Rosert and Sauer argue, "The victim, be she combatant or civilian, is reduced to a data point in an automated killing

---

[18] Egeland, 101.
[19] L. Righetti et al., "Lethal Autonomous Weapon Systems," *IEEE Robotics & Automation Magazine*, March 2018, pp. 123-126, https://doi.org/10.1109/MRA.2017.2787267 p. 124.

[20] Ibid.
[21] Egeland, 90.
[22] Ibid, 107.

machinery that has no conception of what it means to take a human life."[23]

The Human Rights Watch issued a report in 2018 that delves deep into the use of the Martens Clause as an argument in favor of banning LAWS:

Regardless of the sophistication of a fully autonomous weapon, it could not experience emotions. There are some advantages associated with being impervious to emotions such as anger and fear, but a robot's inability to feel empathy and compassion would severely limit its ability to treat others humanely. Because they would not be sentient beings, fully autonomous weapons could not know physical or psychological suffering. As a result, they would lack the shared experiences and understandings that cause humans to relate empathetically to the pain of others, have their "souls stirred," and be driven to exercise compassion towards other human beings.[24]

Responsibility: Finally, a final issue arises when addressing LAWS and IHL: the notion of responsibility. International Law exists to address violations that arise, and to hold entities (persons, organizations, or states) responsible. If the use of an autonomous weapons results in a violation of IHL, the question becomes: who to hold accountable? As Egeland has already pointed out, "autonomous robots obscure the causal link between humans and the actual use of force, which is a prerequisite of accountability."[25] It isn't as simple as holding a manufacturer or computer programmer responsible (unless there was evidence of

malfeasance). While pointing out that states (who direct the armed forces) and the chain of command remain liable for the actions of their agents, the subject of individual responsibility would be much more difficult to ascertain.

2018 Report of the GGE

The Group of Governmental Experts (GGE) continued their work in Geneva into 2018, developing a set of ten "possible guiding principles" (the most up to date can be found in the appendix at the end of this report). All of the principles hearkened back to the affirmation that International Humanitarian Law guides the work of the GGE (the first principle is that IHL "continues to apply fully to all weapons systems, including the potential development and use of lethal autonomous weapons systems."[26])

The second proposed principle stated that "Human responsibility for decisions on the use of weapons systems must be retained since accountability cannot be transferred to machines. This should be considered across the entire life cycle of the weapons system."[27] This concept of addressing LAWS during the weapons entire "life cycle" (not just when a system is deployed, when it will be too late) was depicted in what became known as the Chair's "sunrise slide" (right), visualizing the "human-machine touchpoints in the context of emerging technologies in the area of lethal autonomous weapons systems:"[28]

Accountability and responsibility were mentioned several times, though sometimes

---

[23] Elvira Rosert and Frank Sauer, "Prohibiting Autonomous Weapons: Put Human Dignity First," Wiley Online Library (John Wiley & Sons, Ltd, July 5, 2019), https://onlinelibrary.wiley.com/doi/full/10.1111/1758-5899.12691 p. 372.

[24] Human Rights Watch, "Heed the Call: A Moral and Legal Imperative to Ban Killer Robots," Human Rights Watch (HRW, February 13, 2020), https://www.hrw.org/report/2018/08/21/heed-call/moral-and-legal-imperative-ban-killer-robots

[25] Egeland, 109.

[26] United Nations, "Report of the 2018 Session of the Group of Governmental Experts on Emerging Technologies in the Area of Lethal Autonomous Weapons Systems," United Nations, 23 October 2018), https://www.unog.ch/80256EE600585943/(httpPages)/7C335E71DFCB29D1C1258243003E8724 p. 4.

[27] Ibid.

[28] Ibid, 13.

these ideas were conflated with the concept of control. For example, while discussing Agenda Item 2 (aspects of human-machine interaction), the report states "Human responsibility for the use of force must be retained. To the extent possible or feasible, this could extend to intervention in the operation of a weapon, if necessary to ensure compliance with IHL."[29] Human responsibility (as discussed earlier) is not necessarily dependent on the ability for a human to intervene in the operation of a weapon; that only requires human control ("man-in-the-loop").

An October 2019 U.S. Department of Defense Primer discusses this important difference after noting that U.S. policy:

...requires that all systems, including LAWS, be designed to "allow commanders and operators to exercise appropriate levels of human judgement"...Furthermore "human judgement over the use of force" does not require manual human control of the weapons system...[30]

March 2019 Message to GGE on Banning LAWS

"Autonomous machines with the power and discretion to select targets and take lives without human involvement are politically unacceptable, morally repugnant and should be prohibited by international law."[31] This strongly worded message from Antonio Guterres, the Secretary General of the United Nations, was what greeted the Group of Governmental Experts upon their arrival at the March 2019 meeting in Geneva. Perhaps sensing the slowing momentum the

group had encountered in the face of rapid developments in the fields of AI and weapons development, Guterres stated that it was "time for the panel 'to deliver' on LAWS" and that "The world is waiting, the clock is ticking..."[32]

2019 Report of the GGE

With the Secretary General's statements fresh in their memories, the most recently produced report by the GGE was published on September 25, 2019. The ten guiding principles (no longer referred to as "possible guiding principles") were affirmed, and an 11th was added (listed in the appendix to this report). This additional principle was listed third, after the applicability of IHL to LAWS and the statement that human responsibility for the decisions to use weapons cannot be transferred to machines.

This new principle stated "Human-machine interaction, which may take various forms and be implemented at various stages of the life cycle of a weapon, should ensure that the potential use of weapons systems based on emerging technologies in the area of lethal autonomous weapons systems is in compliance with applicable international law, in particular IHL."[33] This principle appears to codify the "sunrise slide" the Chair had introduced the previous year.

Another principle articulates multiple additional concerns that has been stressed for years by the UN and NGOs: "When developing or acquiring new weapons systems based on emerging technologies in the area of lethal autonomous weapons systems, physical security, appropriate non-physical safeguards (including cyber-

[29] Ibid, 6.
[30] CRS, "Defense Primer: U.S. Policy on Lethal Autonomous Weapon System," U.S. Congressional Research Service, 19 December 2019, https://crsreports.congress.gov/product/pdf/IF/IF11150 p. 1.
[31] "Autonomous Weapons That Kill Must Be Banned, Insists UN Chief," United Nations News, 25 March 2019, https://news.un.org/en/story/2019/03/1035381

[32] Ibid.
[33] United Nations, "Report of the 2019 Session of the Group of Governmental Experts on Emerging Technologies in the Area of Lethal Autonomous Weapons Systems," Group of Governmental Experts on Lethal Autonomous Weapons Systems (LAWS), 25 September 2019, https://www.unog.ch/80256EE600585943/(httpPages)/5535B644C2AE8F28C1258433002BBF14 p.13.

security against hacking or data spoofing), the risk of acquisition by terrorist groups and the risk of proliferation should be considered."[34] While any weapon system presents concerns over proliferation and acquisition by terrorists, the technological nature of LAWS raises the concern over cyber-security and data spoofing to new levels.

Black Box of AI

In September 2020, the United Nations Institute for Disarmament Research (UNIDIR) published a report "The Black Box, Unlocked," describing another conundrum when dealing with Lethal Autonomous Weapons Systems: the requirements for predictability and understandability. "A 'black box' refers is a system for which we know the inputs and outputs but can't see the process by which it turns the former into the latter."[35] Imagine scientists discover a new species of plant that curious brain cancer when consumed by patients, but they have no idea why. They know the input (the plants), and the output (the cancer disappears), but the process by which it occurs is a mystery; this would be a black box.

In various degrees, this is what goes on in Artificial Intelligence, and is why "a high degree of understandability and predictability…will be essential features in any autonomous weapon."[36] Knowing how a LAWS comes to a specific decision given a set of circumstances determines the understandability. "Some forms of AI can be indecipherable even to the humans who built them, let alone the non-technical individuals

who will use them or be subject to their actions."[37] Predictability, on the other hand, describes the degree to which operators know what decisions the LAWS will make. As understandability goes down, it is even more important that predictability goes up.

Arguments Against a Ban

Technology Aiding in Adhering to IHL: Several countries, mostly with active programs involving autonomous and semi-autonomous weapons systems, have been working to modify or limit an outright ban on development and deployment of LAWS. These nations include the China, Israel, Russia, South Korea and the United States. Among these, the U.S. is especially prominent, submitting papers to the GGE while its Department of Defense is taking the issue seriously. Mary Wareham, global coordinator for the Campaign to Stop Killer Robots, "gives credit to the United States for being one of the only countries with a policy on autonomous weapons…(which) says humans must retain judgement over the use of force even in autonomous and semi-autonomous systems."[38]

In these position papers, the United States posits straight-forward (if not overly-simplified) argument in favor of the implementation of *more* autonomous systems on the battlefield: the smarter weapons have become, the better equipped warfighters are at abiding by International Humanitarian Law (in a 2017 position paper to the GGE, the US devoted an entire section to the "Potential for autonomy in weapon systems to improve the implementation

---

[34] Ibid.
[35] Arthur Holland Michel, The Black Box, Unlocked, Geneva: United Nations Institute for Disarmament Research, 22 September 2020, https://unidir.org/publication/black-box-unlocked p. iii.
[36] Arthur Holland Michel, "In the Debate over Autonomous Weapons, It's Time to Unlock the 'Black Box' of AI," Bulletin of the Atomic Scientists, 16 October 2020,

https://thebulletin.org/2020/10/ban-regulate-or-do-nothing-the-debate-over-ai-weapons-and-one-path-forward/
[37] Michel, "The Black Box, Unlocked," op.cit., 9.
[38] Rebecca Kheel, "Fighting the Rise of the Machines," The Hill, 6 March 2018, https://thehill.com/business-a-lobbying/lobbyist-profiles/376851-fighting-the-rise-of-the-machines p.15.

of law of war principles in military operations."[39] On the eve of widespread deployment of Precision Guided Munitions at the onset of Desert Storm, U.S. Air Force B-52 bombers were still carpet bombing Iraqi positions. The U.S. argues *not* implementing the use of Artificial Intelligence on the battlefield, if it works, could be considered a violation of IHL.

Ethical Robots: some authors go further in favor of the use of LAWS. Egeland quotes roboticist Ronald Arkin, who has worked to develop "target classification to protect sites such as hospitals and schools"[40] and who believes the lack of emotional response by machines could lead to a more humane battleground:

It is not my belief that unmanned systems will be able to be perfectly ethical in the battlefield, but I am convinced that they can perform more ethically than human soldiers are capable of. Unfortunately the trends in human behavior in the battlefield regarding adhering to legal and ethical requirements are questionable at best.[41]

Most NGOs take the position that this lack of human emotion precludes the possibility of LAWS acting in a moral way; "Actors are required: (1) to treat others humanely, and (2) to show respect for human life and dignity. Due to their lack of emotion and judgment, fully autonomous weapons would face significant difficulties in complying with either."[42]

Take a hypothetical situation where a state or armed group initiates an ethnic cleansing campaign against some of its people. Instructions would need to be issued to a commander, who would order to the field

commanders, and eventually troops responsible for any attack. Any of those levels of command could refuse to follow that order. Indeed, everyone in the chain of command would be held responsible under International Humanitarian Law. With LAWS, hypothetically everyone but the national leader could be "cut out" of the chain of command; the LAWS will simply follow orders, and cannot be held responsible for its actions.

Military Utility: A barrier to an international community ban on LAWS is the game-changing nature of AI weaponry. This is apparent in the development of "swarm tactics" using unmanned combat aerial vehicles (UCAVs), as detailed in Tyler Rogoway's 2016 article in the online journal "The Drive:"

With a swarm of dozens, or even hundreds of networked UCAVs fighting all at 100 percent efficiency at all times, the enemy is faced with the monumental task of defending themselves against such an efficient, agile and persistent foe...

Advanced tactics...could be executed by the swarm's best available assets to solve a tactical problem, even an unplanned one. Based on pre-programmed directives, the swarm can instantly vector the right pairing of assets to take out a particular threat or perform a certain task at hand...the swarm's software would have pre-loaded responses to various stimuli and situations with a certain amount of AI built in to cope with complex scenarios. In a fully autonomous fashion, the swarm will make the decision of how to deal with the threat based on

---

[39] Group of Government Experts of the High Contracting Parties to the Convention on Prohibitions or Restrictions on the Use of Certain Conventional Weapons Which May Be Deemed to Be Excessively Injurious or to Have Indiscriminate Effects, New York: United National, 10 November 2017, https://www.onug.ch/80256EDD006B8954/(httpAssets)/7C177AE5BC10B588C125825F004B06BE/$file/CCW_GGE.1_2018_WP.4.pdf p. 3.

[40] Frank Pasquale, "'Machines Set Loose to Slaughter': the Dangerous Rise of Military AI," The Guardian, 15 October 2020, https://www.theguardian.com/news/2020/oct/15/dangerous-rise-of-military-ai-drone-swarm-autonomous-weapons?ref=hvper.com
[41] Egeland, 101.
[42] HRW.

its programming without a human interrupting its onslaught…[43]

Rogoway, approaching from a capabilities perspective, is critical of keeping a "man in the loop" when it comes to LAWS: "This method, although maybe politically more accommodating, handicaps the true crushing offensive potential of the swarm."[44] Rogoway boldly states "The fact is that autonomy will become a reality far sooner than most think it will, regardless of if we like it or not."[45]

Examples of LAWS Development

The launch vehicle for swarming, loitering munitions, being tested in China.[46]

The preceding examples hint at the autonomy that is being developed in current weapon systems. PAX, a non-governmental organization, published a more extensive guide entitled "Where to draw the line: Increasing Autonomy in Weapon Systems – Technology and Trends." In it, PAX outlines 25 different systems within 8 categories (Loitering Munitions, Unmanned Combat Aircraft, Precision Guided Munitions, Unmanned Ground Vehicles, Unmanned Marine Vehicles, Border Control, Counter Terrorism and Law

Enforcement, and Anti-Animal). These are systems that are being marketed by weapons manufactures, and all have links to specifications and demonstration videos.

Note the categories "Border Control," "Law Enforcement" and "Anti-Animal." This highlights the fact that these technologies are far from military-specific, and therefore cannot be controlled solely through military channels. Consider the COTSBOT, a weapon developed to protect Australia's Great Barrier Reef from an invasive species called the crown-of-thorns starfish (COTS) population:

Equipped with stereoscopic cameras to give it depth perception, five thrusters to maintain stability, GPS and pitch-and-roll sensors, and a unique pneumatic injection arm to deliver a fatal dose of bile salts…The system is backed by "serious computational power" and can think and learn for itself in the water: "If the robot is unsure that something is actually a COTS, it takes a photo of the object to be later verified by a human, and that human feedback is incorporated into the robot's memory bank.[47]

The COTSBOT is not some future technology; it is a non-military ecological support robot currently working to save the Great Barrier Reef from an invasive species using Artificial Intelligence and lethal injections. The potential dual-use nature of the system is obvious.

Non-Aligned Movement: Participation in the GGE forum translated to a greater percentage of countries calling for a ban on LAWS. According to Bode, statements by the Global South have become "more forceful and coordinated," focusing on the potential for LAWS to change the very nature of warfare as well as "their

---

[43] Tyler Rogoway, "The Alarming Case of The USAF's Mysteriously Missing Unmanned Combat Air Vehicles"
[44] Ibid.
[45] Ibid.
[46] Joseph Trevithick, "China Conducts Test Of Massive Suicide Drone Swarm Launched From A

Box On A Truck," The Drive, 14 October 2020, https://www.thedrive.com/the-war-zone/37062/china-conducts-test-of-massive-suicide-drone-swarm-launched-from-a-box-on-a-truck
[47] Slijper, 17.

destabilizing potential in terms of lowering use of force thresholds."[48]

Turkey: Although Turkey has been a regular member of the talks in Geneva regarding LAWS. Turkish official said that, since such weapons were only hypothetical, the requirement for a general prohibition on LAWS was premature.

According to Human Rights Watch, "Turkey is developing, producing, and using various weapons systems with autonomous functions." 18 June 2020 – The Turkish military reportedly plans to buy more than 500 quad-copter-type Kargu series loitering munitions, or suicide drones, in the near term. The Kargus, at present, can operate in semi-autonomous or manually-controlled modes, but work is underway to give up to 20 of them the ability to carry out mass attacks as a swarm, which could give Turkey's troops a potentially game-changing new capability…it was working to give the…drones additional autonomy and the ability to work together rin large swarms.[49]

The Turkish development highlights the possibility of LAWS being proliferated around the globe in the very near future: "(the manufacturer) has already says it has received serious inquiries about the Kargu series from at least three unnamed potential foreign customers."[50]

United Kingdom is an active participant in every CCW meeting on LAWS since their inception. The United Kingdom has stated that, while "there must always be human oversight and authority in the decision to strike, it takes the

position that "existing international humanitarian law (is) 'sufficient to regulate the use' of lethal autonomous weapons and 'therefore has no plans to call for or to support an international ban on them.'"[51] The U.K. is moving forward, meanwhile, on the development and production of such weapons.

8 October 2020 – Italian defense contractor Leonardo says that it has conducted a successful demonstration in cooperation with the U.K. Royal Air Force of an autonomous swarm of unmanned aircraft, each carrying a variant of its BriteCloud expendable active decoy as an electronic warfare payload…the drones were able to launch a mock non-kinetic attack on radars acting as surrogates for a notional enemy integrated air defense network.[52]

The UK test above highlights yet another concern of that LAWS presents to global peace: this technology is making war cheaper, and thus more attractive, option. "If you lose one and its drone platform, it isn't a big deal as they are meant to be expendable…cheap enough for commanders to be willing to commit them to higher-risk missions…"[53] In the past, penetrating a sophisticated air defense network would mean the expenditure of millions of dollars and perhaps human lives, raising the bar to a potential conflict. With the low-cost option LAWS presents, nation-state conflict may become more commonplace.

United States is an active participant in UN meetings on LAWS. But, "The U.S. is investing heavily in military applications of artificial intelligence and developing air, land, and sea-based autonomous weapons systems."[54] The

---

[48] Ibid.
[49] Joseph Trevithick, "Turkey Now Has Swarming Suicide Drones It Could Export," The Drive, 19 June 2020, https://www.thedrive.com/the-war-zone/34204/turkey-now-has-a-swarming-quadcopter-suicide-drone-that-it-could-export
[50] Ibid.
[51] Stauffer.

[52] Joseph Trevithick, "RAF Uses Autonomous Drone Swarm Loaded With Decoys to Overwhelm Mock Enemy Air Defenses," The Drive, 8 October 2020, https://www.thedrive.com/the-war-zone/36950/raf-tests-swarm-loaded-with-britecloud-electronic-warfare-decoys-to-overwhelm-air-defenses
[53] Ibid.
[54] Brian Stauffer, "Stopping Killer Robots," Human Rights Watch, 10 August 2020,

2019 DoD Communication Playbook indicated that the US would be investing AI across the department, including on the battlefield. The publication couched its reasoning in classic security dilemma terms: "Competitors like Russia and China invest heavily in artificial intelligence to redefine future warfare; we must do the same to maintain our competitive advantage."[55]

The use of swarm tactics requires at least some level of autonomy, as it would be impractical for each drone to have a dedicated human controller. Considering the targets mentioned, these would be eventually become lethal.

29 December 2019: The U.S. Air Force hired Lockheed Martin and Northrop Grumman to develop experimental low-coast cruise missiles that can act as a swarm in order to better navigate through or overwhelm enemy defense networks…Another of the Gray Wolf project's goals is to have the entire group be able to find and strike targets on their own after launch, based on a set of pre-set parameters…The goal of the program is to demonstrate experimental low-cost weapons that can plot their own strikes.[56]

The article above highlights two additional issues with the continued development of LAWS technology. The first is that, as technological hurdles are leaped, the end product is becoming cheaper even as it becomes more capable. From a proliferation standpoint (even to non-state actors), this is a genuine concern. The second issue is that due to the cutting-edge nature of the Research and Development

programs involving AI, programs are highly classified: "This isn't particularly surprising for a science and technology effort, which will focus on exploring new concepts…"[57] This presents a challenge when it comes to inspection and verification should LAWS eventually be banned or regulated under an international protocol.

For example: The U.S. Army released expectations for a new family of air-launched multi-purpose unmanned aircraft, which will include types capable of operating as scouts, electronic attackers, decoys, and even suicide drones. They…may be able to work together by themselves as a fully-autonomous, networked swarm…The…drones would also be paired with artificial intelligence-driven machine learning algorithms to automatically identify potential targets of interest…Swarms of (drones) operating autonomous or semi-autonomously could also seek to push into higher-risk areas to find time-sensitive or otherwise high-priority targets.[58]

Proposals for Further Action

While the weapons industry and developed nations race to design munitions they hardly understand, those organizations dedicated to global peace, bound by consensus-building and bureaucratic atrophy, are failing to keep up.

The questions that need to be answered range from the definitional (*what's the difference between semi-autonomous and autonomous?*) to the moral (*should robots be able to make*

https://www.hrw.org/report/2020/08/10/stopping-killer-robots/country-positions-banning-fully-autonomous-weapons-and
[55] Kjølv Egeland, "Lethal Autonomous Weapon Systems under International Humanitarian Law," *Nordic Journal of International Law* 85, no. 2 (2016): pp. 89-118, https://doi.org/10.1163/15718107-08502001
[56] Joseph Trevithick, "USAF Wants Swarms of Cheap 'Gray Wolf' Cruise Missiles That Can Overwhelm Enemy Defenses," The Drive, 29

December 2017, https://www.thedrive.com/the-war-zone/17257/usaf-wants-swarms-of-cheap-gray-wolf-cruise-missiles-that-can-overwhelm-enemy-defenses
[57] Ibid.
[58] Joseph Trevithick, "The Army Has Unveiled Its Plan For Swarms Of Electronic Warfare Enabled Air-Launched Drones," The Drive, 16 August 2020, https://www.thedrive.com/the-war-zone/35726/the-army-has-unveiled-its-plan-for-swarms-of-electronic-warfare-enabled-air-launched-drones

decisions about killing humans?), from the practical (*how do you keep a cheap, widely available technology with the ability to produce boundless good from being used for evil*) to the philosophical (*how do we define our humanness?*). It is a monumental task, and the timing and impact of the COVID-19 crisis could not have come at a worse time.

Still, the task remains, and the greater the challenge, the more worthwhile the endeavor. While the odds may be long, there is no organization other than the United Nations with the potential to find a solution, whether that be a ban on LAWS, declarations on practical restrictions, or enforcement of current international law in relation to LAWS.

Proposals

- *Direct the UN to complete a treaty*: call for the outright ban on Lethal Autonomous Weapons Systems. This would, be necessity, require a formally approved definition of LAWS to be settled upon, which will be very difficult for a body like the GGE. This would address concerns of nations of the Global South as well as the numerous non-governmental organizations attempting to address this problem. Unfortunately, this would receive stiff resistance from nations like China, Russia, or the United States and other countries that are currently developing and producing such weapons.

- Reaffirm the principles of international humanitarian law (IHL) in LAWS. Stress the need to develop a specific regime applying IHL to autonomous weapon systems. For example, require autonomous systems to be able to differentiate between combatants and civilians on the battlefield. This can be done in such a way that it, in effect, bans LAWS (set the bar so high

current technology won't be able to achieve it), but be aware that this may also drive producer countries away from the negotiating table.

- Adopt a position that current IHL and other regimes are sufficient to address any current or future concerns regarding LAWS, without creating specific new language to take autonomous weapons into consideration. This will appease producer countries such as Russia and the United States, but will the force nations of the Global South and non-governmental organizations to seek alternate routes to addressing the threat.

- *Reserve the issue for national resolution*: The Member States could agree this is an issue for which universal principle are neither helpful or desirable, and resolve that the question should be addressed exclusively the Member States acting independently. This is a default option. If the body does nothing, this would be the effect.

- *Authorize a new study*: If the body is divided on the issue, it might choose instead to authorize a new Study by a Group of Government Experts, to resolve some of the questions below. Alternatively, the body might agree to resolve some of these questions itself in normal debate, through the resolution process.

Possible questions to be addressed[59]

- Can LAWS be permitted if they comply with international humanitarian law?
- Can LAWS be permitted if they distinguish between soldiers and civilians, and ascertain whether an attack is proportional?
- Who is responsible if LAWS harm innocent people or property? Are the

---

[59] From PAX, 'Where to Draw the Line', op.cit., and 2019 GGE Report, op.cit.

using state's military or law enforcement agencies responsible, are the suppliers, if the weapons were imported?

- When if at all is it legally acceptable for law enforcement agencies to use such technology?

- How is responsibility ensured for the use of force with existing weapons that employ or can be employed with autonomy in their critical functions? Must there always be a human in the loop? Are there conditions under which autonomy is acceptable?

- Is autonomy an attribute of a weapon system as a whole or should it be attached to different tasks of weapons systems?

- Is a differentiation between anti-personnel and anti-materiel weapons meaningful from an IHL/CCW perspective?

- Does autonomy in the critical functions of weapons systems challenge the maintenance of combatant and commander responsibility for decisions to use force?

- What is the responsibility of States or parties to a conflict, commanders, and individual combatants in decisions to use force involving autonomous weapons systems

- What type and degree of human involvement (in the form of control, oversight and/or judgement) is required or appropriate when using weapons with autonomy in their critical functions to ensure compliance with IHL?

- What is the form and degree, if any, of human supervision – such as the ability to intervene and abort – which, during the operation of a weapon that can autonomously select and attack targets, may be deemed sufficient for compliance with IHL?

- Is there a level of predictability and reliability that would be required or appropriate in the autonomous functions of such a weapons system, considering the weapon's foreseeable tasks and operational environment, for its use to be consistent with IHL?

- Can IHL-compliant human-machine interaction be required and ensured as a condition for lethal autonomy?

Appendix: Guiding Principles for the UN Group of Governmental Experts, 2019

(a) International humanitarian law continues to apply fully to all weapons systems, including the potential development and use of lethal autonomous weapons systems;

(b) Human responsibility for decisions on the use of weapons systems must be retained since accountability cannot be transferred to machines. This should be considered across the entire life cycle of the weapons system;

(c) Human-machine interaction, which may take various forms and be implemented at various stages of the life cycle of a weapon, should ensure that the potential use of weapons systems based on emerging technologies in the area of lethal autonomous weapons systems is in compliance with applicable international law, in particular IHL. In determining the quality and extent of human-machine interaction, a range of factors should be considered including the operational context, and the characteristics and capabilities of the weapons system as a whole;

(d) Accountability for developing, deploying and using any emerging weapons system in the framework of the CCW must be ensured in accordance with applicable international law, including through the operation of such systems within a responsible chain of human command and control;

(e) In accordance with States' obligations under international law, in the study, development, acquisition, or adoption of a new weapon, means or method of warfare, determination must be made whether its employment would, in some or all circumstances, be prohibited by international law;

(f) When developing or acquiring new weapons systems based on emerging technologies in the area of lethal autonomous weapons systems, physical security, appropriate non-physical safeguards (including cyber-security against hacking or data spoofing), the risk of acquisition by terrorist groups and the risk of proliferation should be considered;

(g) Risk assessments and mitigation measures should be part of the design, development, testing and deployment cycle of emerging technologies in any weapons systems;

(h) Consideration should be given to the use of emerging technologies in the area of lethal autonomous weapons systems in upholding compliance with IHL and other

applicable international legal obligations;

(i) In crafting potential policy measures, emerging technologies in the area of lethal autonomous weapons systems should not be anthropomorphized;

(j) Discussions and any potential policy measures taken within the context of the CCW should not hamper progress in or access to peaceful uses of intelligent autonomous technologies;

(k) The CCW offers an appropriate framework for dealing with the issue of emerging technologies in the area of lethal autonomous weapons systems within the context of the objectives and purposes of the Convention, which seeks to strike a balance between military necessity and humanitarian considerations.

Bibliography

Bode, Ingvild. "Norm-Making and the Global South: Attempts to Regulate Lethal Autonomous Weapons Systems," Wiley Online Library, 20 June 2019, https://onlinelibrary.wiley.com/doi/10.1111/1758-5899.12684

CRS, "Defense Primer: U.S. Policy on Lethal Autonomous Weapon System," U.S. Congressional Research Service, 19 December 2019, https://crsreports.congress.gov/product/pdf/IF/IF11150 p. 1.

Egeland, Kjølv. "Lethal Autonomous Weapon Systems under International Humanitarian Law," *Nordic Journal of International Law* 85, no. 2 (2016): pp. 89-118, https://doi.org/10.1163/15718107-08502001 p. 94.

Future of Life Institute. "An Open Letter to the United Nations Convention on Certain Conventional Weapons," Future of Life Institute, 11 January 2019, https://futureoflife.org/autonomous-weapons-open-letter-2017/

GGE 2017. *Report of the 2017 Group of Governmental Experts on Lethal Autonomous Weapons Systems (LAWS)* Geneva: United Nations, 2017, p. 7.

GGE 2017. Group of Government Experts of the High Contracting Parties to the Convention on Prohibitions or Restrictions on the Use of Certain Conventional Weapons Which May Be Deemed to Be Excessively Injurious or to Have Indiscriminate Effects, New York: United Nations, 10 November 2017, https://www.onug.ch/80256EDD006B8954/(httpAssets)/7C177AE5BC10B588C125825F004B06BE/$file/CCW_GGE.1_2018_WP.4.pdf p. 3.

GGE 2017. Report of the 2017 Session of the Group of Governmental Experts on Emerging Technologies in the Area of Lethal Autonomous Weapons Systems. Group of Governmental Experts on Lethal Autonomous Weapons Systems (LAWS). UN, 22 December 2017. https://www.unog.ch/80256EE600585943/(httpPages)/F027DAA4966EB9C7C12580CD0039D7B5 .

GGE. Report of the 2018 Session of the Group of Governmental Experts on Emerging Technologies in the Area of Lethal Autonomous Weapons Systems. 2018 Group of Governmental Experts on Lethal Autonomous Weapons Systems (LAWS), 23 October 2018. https://www.unog.ch/80256EE600585943/(httpPages)/7C335E71DFCB29D1C1258243003E8724

GGE. "Report of the 2019 Session of the Group of Governmental Experts on Emerging Technologies in the Area of Lethal Autonomous Weapons Systems." Group of Governmental Experts on Lethal Autonomous Weapons Systems (LAWS), 25 September 2019. https://www.unog.ch/80256EE600585943/(httpPages)/5535B644C2AE8F28C1258433002BBF14 .

Gill, Amandeep S. "The Role of the United Nations in Addressing Emerging Technologies in the Area of Lethal Autonomous Weapons Systems," *UN Chronicle*, vol. 55, no. 4 (2019), pp. 15-17, https://doi.org/10.18356/87196c84-en

Gill, Amandeep Singh. *Food-for-Thought Paper: Group of Governmental Experts of the States Parties to the Convention on Prohibitions or Restrictions on the Use of Certain Conventional Weapons Which May Be Deemed to Be Excessively Injurious or to Have Indiscriminate Effects, Geneva, 13-17 November 2017.* Geneva: United Nations, 2017.

Human Rights Watch, "Heed the Call: A Moral and Legal Imperative to Ban Killer Robots," Human Rights Watch, 13 February 2020, https://www.hrw.org/report/2018/08/21/heed-call/moral-and-legal-imperative-ban-killer-robots

Kheel, Rebecca. "Fighting the Rise of the Machines," The Hill, 6 March 2018, https://thehill.com/business-a-lobbying/lobbyist-profiles/376851-fighting-the-rise-of-the-machines p.15.

Michel, Arthur Holland. *The Black Box, Unlocked,* Geneva: United Nations Institute for Disarmament Research, 22 September 2020, https://unidir.org/publication/black-box-unlocked p. iii.

Michel, Arthur Holland. "In the Debate over Autonomous Weapons, It's Time to Unlock the 'Black Box' of AI," Bulletin of the Atomic Scientists, 16 October 2020, https://thebulletin.org/2020/10/ban-regulate-or-do-nothing-the-debate-over-ai-weapons-and-one-path-forward/

Pasquale, Frank 'Machines Set Loose to Slaughter': the Dangerous Rise of Military AI,' The Guardian, 15 October 2020, https://www.theguardian.com/news/2020/oct/15/dangerous-rise-of-military-ai-drone-swarm-autonomous-weapons?ref=hvper.com

Righetti, L., Q. C. Phan, R. Madhavan, and R. Chatila. "Lethal Autonomous Weapon Systems." IEEE Robotics & Automation Magazine, March 2018, 123–26. https://doi.org/10.1109/MRA.2017.2787267 .

Rogoway, Tyler. "The Alarming Case Of The USAF's Mysteriously Missing Unmanned Combat Air Vehicles," The Drive, 9 June 2016, https://www.thedrive.com/the-war-zone/3889/the-alarming-case-of-the-usafs-mysteriously-missing-unmanned-combat-air-vehicles

Rogoway, Tyler. "ISIS Drone Dropping Bomblet On Abrams Tank Is Just A Sign Of What's To Come." The Drive. 26 January 2017. https://www.thedrive.com/the-war-zone/7155/isis-drone-dropping-bomblet-on-abrams-tank-is-a-sign-of-whats-to-come

Rosert, Elvira and Frank Sauer. "Prohibiting Autonomous Weapons: Put Human Dignity First," Wiley Online Library (John Wiley & Sons, 5 July 2019, https://onlinelibrary.wiley.com/doi/full/10.1111/1758-5899.12691 p. 372.

Simak Vojtech, et al. "Why Lethal Autonomous Weapon Systems Are Unacceptable ," IEEE 15th International Symposium on Applied Machine Intelligence and Informatics, IEEE, January 2017, https://www.researchgate.net/publication/315865048_Why_Lethal_autonomous_weapon_systems_are_unacceptable p. 361.

Slijper, Frank. "Where to Draw the Line," PAX, April 2018, https://www.paxforpeace.nl/publications/all-publications/where-to-draw-the-line p. 7.

Stauffer, Brain. "Stopping Killer Robots," Human Rights Watch, 10 August 2020, https://www.hrw.org/report/2020/08/10/stopping-killer-robots/country-positions-banning-fully-autonomous-weapons-and

Trevithick, Joseph. "The Army Has Unveiled Its Plan For Swarms Of Electronic Warfare Enabled Air-Launched Drones," The Drive, 16 August 2020, https://www.thedrive.com/the-war-zone/35726/the-army-has-unveiled-its-plan-for-swarms-of-electronic-warfare-enabled-air-launched-drones

Trevithick, Joseph. "China Conducts Test Of Massive Suicide Drone Swarm Launched From A Box On A Truck," The Drive, 14 October 2020, https://www.thedrive.com/the-war-zone/37062/china-conducts-test-of-massive-suicide-drone-swarm-launched-from-a-box-on-a-truck

Trevithick, Joseph. "Turkey Now Has Swarming Suicide Drones It Could Export," The Drive, 19 June 2020, https://www.thedrive.com/the-war-zone/34204/turkey-now-has-a-swarming-quadcopter-suicide-drone-that-it-could-export

Trevithick, Joseph. "RAF Uses Autonomous Drone Swarm Loaded With Decoys To Overwhelm Mock Enemy Air Defenses," The Drive, 8 October 2020, https://www.thedrive.com/the-war-zone/36950/raf-tests-swarm-loaded-with-britecloud-electronic-warfare-decoys-to-overwhelm-air-defenses

Trevithick, Joseph. "The US Navy Wants Its EA-18G Growlers to Drop Canisters With Drones Tucked Inside," The Drive, 7 December 2017, https://www.thedrive.com/the-war-zone/16758/the-us-navy-wants-its-ea-18g-growlers-to-drop-canisters-with-drones-tucked-inside

Trevithick, Joseph. "USAF Wants Swarms of Cheap 'Gray Wolf' Cruise Missiles That Can Overwhelm Enemy Defenses," The Drive, 29 December 2017, https://www.thedrive.com/the-war-zone/17257/usaf-wants-swarms-of-cheap-gray-wolf-cruise-missiles-that-can-overwhelm-enemy-defenses

UN News. "Autonomous Weapons That Kill Must Be Banned, Insists UN Chief," United Nations News, 25 March 2019, https://news.un.org/en/story/2019/03/1035381

United Nations, "Report of the 2018 Session of the Group of Governmental Experts on Emerging Technologies in the Area of Lethal Autonomous Weapons Systems," United Nations, 23 October 2018, https://www.unog.ch/80256EE600585943/(httpPages)/7C335E71DFCB29D1C1258243003E8724 p. 4.

United States. "Autonomy in Weapon Systems Submitted by the United States of America." Group of Government Experts of the High Contracting Parties to the Convention on Prohibitions or Restrictions on the Use of Certain Conventional Weapons Which May Be Deemed to Be Excessively Injurious or to Have Indiscriminate Effects. UN, 10 November 2017, https://www.onug.ch/80256EDD006B8954/(httpAssets)/7C177AE5BC10B588C125825F004B06BE/$file/CCW_GGE.1_2018_WP.4.pdf

Wyatt, Austin. "So Just What Is a Killer Robot?: Detailing the Ongoing Debate around Defining Lethal Autonomous Weapon Systems," Washington Headquarters Services, 8 June 2020, https://www.whs.mil/News/News-Display/Article/2210967/so-just-what-is-a-killer-robot-detailing-the-ongoing-debate-around-defining-let/