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LETHAL AUTONOMOUS WEAPON SYSTEMS : A CLEAR AND PRESENT DANGER

Lieutenant-Commander Daniel Rice

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**LETHAL AUTONOMOUS WEAPON SYSTEMS:
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By Lieutenant-Commander Daniel Rice

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INTRODUCTION

Autonomous weapons select and engage targets without human intervention… Artificial Intelligence (AI) technology has reached a point where the deployment of such systems is -- practically if not legally -- feasible within years, not decades, and the stakes are high: autonomous weapons have been described as the third revolution in warfare, after gunpowder and nuclear arms. Autonomous weapons are ideal for tasks such as assassinations, destabilising nations, subduing populations and selectively killing a particular ethnic group. If any major military power pushes ahead with AI weapon development, a global arms race is virtually inevitable, and the endpoint of this technological trajectory is obvious: autonomous weapons will become the Kalashnikovs of tomorrow.

– Open letter from the 2015 International Joint Conference on Artificial Intelligence

Warfare in the twenty-first century has, along with nearly every aspect of civilization, seen incredible technological advances. Increasingly that technology is enabling machines to perform tasks that could only previously be performed by a human. Tesla electric cars have self-driving abilities, United States Air Force's X47-B has demonstrated the ability to autonomously take-off and land from an aircraft carrier and conduct aerial refuelling, and United States Navy's *Sea Hunter* autonomously completed a round trip between California and Hawaii.[1] The rise in capability of autonomous systems, aided by artificial intelligence (AI), will alter the very nature of warfare by removing the one consistent element which has always been present in warfare – the human. Autonomous systems can reduce the risk to human life and make forces more combat effective; however, one area of concern which arises from the development of these systems are Lethal Autonomous Weapon Systems (LAWS) – systems with the ability to

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[1] Vincent Boulanin and Maaike Verbruggen, "Mapping the Development of Autonomy in Weapon Systems," *Stockholm International Peace Research Institute*, 2017, 80; Megan Eckstein, "Navy Racing to Test , Field Unmanned Maritime Vehicles for Future Ships," U.S. Naval Institute, 2019, 6, https://news.usni.org/2017/09/21/navy-racing-test-field-unmanned-maritime-vehicles-future-ships.

employ lethal force *without* human interaction. LAWS present an ethical and legal quagmire: Should a machine be allowed to decide who, how and when to kill a human? Can a machine adhere to International Humanitarian Law (IHL)? This essay will argue that LAWS are not ethical nor should they be legal, and that Canada should join the call for a ban on their development.

While the terms "automated" and "autonomous" are not universally defined when it comes to robotic or computer systems, for the purposes of this essay the term "automated" will refer to systems which retain an element of human control – a human-in-the-loop or human-on-the-loop who retains meaningful control of critical function.[2] These would include systems such as Israel's Iron Dome, which can detect incoming rockets, calculate trajectories for an interceptor rockets, and then await the launch order from its human operator; or NATO's Phalanx Close-In Weapons Systems which can protect warships from incoming anti-ship missiles by detecting, tracking, and engaging them with minimal oversight from a human operator; or South Korea's SGR-A1 Sentry Robot which can use pattern recognition to recognize humans in the Demilitarized Zones (DMZ), issue warnings, and can engage with machine gun fire operated remotely by a human operator.[3] The term "autonomous" will refer to systems that operate independently of human control – a human-out-of-the-loop. This would include systems such as the same SGR-A1 Sentry Robot when it is placed in Unsupervised Mode whereby it can fire on intruders in the DMZ without any intervention by human operators.[4] Building upon these concepts, LAWS can be defined as any system "capable of targeting and initiating the use of potentially lethal

[2] Frank Slijper, "Where to Draw the Line? Increasing Autonomy in Weapon Systems – Technology and Trends" (Utrecht, 2018), 6.
[3] Amitai Etzioni and Oren Etzioni, "Pros and Cons of Autonomous Weapons Systems," *Military Review*, no. May-June (2017): 79.
[4] Slijper, "Where to Draw the Line? Increasing Autonomy in Weapon Systems – Technology and Trends," 16.

force without direct human supervision and direct human involvement in the lethal decision-making."[5]

These examples are not meant to show that autonomous systems are inherently bad. They have great military potential outside of the LAWS category in the so-called "D3" jobs – dull, dangerous or dirty – jobs that are repetitive in nature or that require extreme endurance (e.g. persistent aerial surveillance), jobs that put humans into harms way (e.g. disarming improvised explosive devices), or jobs that unpleasant or unhealthy (e.g. chemical, biological, radiological, nuclear, explosive (CBRNE) reconnaissance).[6] In these contexts, autonomous systems can be very beneficial. The concern lies though with autonomous systems which have the ability to take the life a human being, rather than those which simply perform unappealing tasks.

THE SLIPPERY SLOPE

The decision to take the life of a human being is legal under International Humanitarian Law (IHL) during armed conflict, provided that two key principles are followed: distinction and proportionality.[7] The principle of distinction requires parties in armed conflict to distinguish between civilians and combatants, as well as between civilian objects and military objectives; it then further limits legitimate operations to only combatants and military objectives.[8] The principle of proportionality prohibits attacks

[5] Peter Asaro, "On Banning Autonomous Weapon Systems: Human Rights, Automation, and the Dehumanization of Lethal Decision-Making," *International Review of the Red Cross* 94, no. 886 (2012): 687–709.

[6] Department of Defense, "Office of the Secretary of Defense Umanned Systems Roadmap (2007-2032)," 2007, 23.

[7] Asaro, "On Banning Autonomous Weapon Systems: Human Rights, Automation, and the Dehumanization of Lethal Decision-Making," 696.

[8] International Committee of the Red Cross, "Distinction," How does law protect in war?, 2019, 1, https://casebook.icrc.org/print/20357.

against military objectives which would cause civilian deaths or injuries, or damage to civilian objects unless they were proportional to the "concrete and direct military advantage anticipated."[9] To consider these principles together, IHL forbids civilian from being targeted unless there is a proportional and clear military advantage to be gained. This requires both the ability positively identify civilians and civilian objects along with the ability to weigh the potential civilian losses against the potential military gains. Currently these are principles considered only by human operators, whether in-the-loop or on-the-loop. However, if LAWS are employed on the battlefield, these systems themselves must make these determinations.

Opponents of LAWS argue that machines would be unable to adhere to the principle of distinction for three main reasons. Firstly, machines lack the ability to distinguish between civilians and combatants (which is difficult even for humans, and especially so during insurgent warfare),[10] and they cannot recognize wounded or surrendering combatants. Secondly, even with improvements in sensing and processing technology, there is no clear definition of a civilian under IHL. The Geneva Protocol I essentially defines civilians as those who are not combatants. Therefore, there is no ability to program in a hard description of civilian, as compared to a combatant, into a computer. It requires judgement – another element that machines lack. And thirdly, there is no clear indication that machines will have these abilities in the near future.[11] That is to say that the technology to arm machines with lethal capabilities is much farther ahead than the technology to legally employ those lethal capabilities.

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[9] International Committee of the Red Cross, "Proportionality," How does law protect in war?, 2019, 1, https://casebook.icrc.org/print/20530.
[10] Etzioni and Etzioni, "Pros and Cons of Autonomous Weapons Systems," 75.
[11] Noel Sharkey, "The Evitability of Autonomous Robot Warfare," *International Review of the Red Cross* 94, no. 886 (2013): 788–89.

The concept of distinction, while binary in the legal sense, is far from binary in the practical sense. Take for example the case of a civilian participating in hostilities. The International Committee of the Red Cross (ICRC) offers guidelines on how to determine if a civilian participating in hostilities can be deemed a legitimate target. There must first be a threshold of harm, then direct causation, and finally a belligerent nexus. These guidelines collectively require that the act taken by a civilian must be such that it directly causes the required threshold of harm to the detriment of an opposing party in an armed conflict. And if all three of these guidelines are not met, then the civilian retains his protection against direct attack.[12] Again, these terms and concepts are not something which can be defined discretely for a machine to understand.

Similarly, the concept of proportionality is not something that can be easily calculated. It requires judgment and situational awareness. A machine would require a metric to assign value to both the potential for civilian harm and the military value gained in order to assess proportionality. While there is a metric for evaluating the likelihood of collateral damage around a target using Collateral Damage Estimate Models (CDEM), there is no formal methodology to evaluating military advantage as it is ultimately a subjective matter based on the circumstances and conditions of the moment.[13] At best, a machine could contribute to an assessment of proportionality by selecting the most appropriate weapon system or the minimum yield size to best achieve the military objective, thereby reducing the probability to harm to civilians; however, a machine cannot make a full

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[12] Asaro, "On Banning Autonomous Weapon Systems: Human Rights, Automation, and the Dehumanization of Lethal Decision-Making."

[13] Noel Sharkey, "Saying 'No!' to Lethal Autonomous Targeting," *Journal of Military Ethics* 9, no. 4 (2010): 380; Michael N. Schmitt and Jeffrey S. Thurner, "Out of the Loop: Autonomous Weapon Systems and the Law of Armed Conflict," *Harvard Journal of National Security* 4 (2013): 254.

determination of proportionality for itself as it lacks the context, situational awareness, experience and intuition of human operator.[14]

Another aspect of IHL which causes concern with the potential employment of LAWS is the concept of accountability. In the event that the system violates either the distinction or proportionality principles, the system itself cannot be held accountable. So the question therefore becomes one of whom to hold accountable instead. With conventional weapons, the chain of accountability reaches from the human who actually fired the weapon through to the commander who ordered the engagement and potentially up to those who approved the campaign and the associated rules of engagement.[15] With LAWS, the blame would not lie along a single chain of command: it may lie with the operator who programmed its orders, it may lie with the commander for employing it inappropriately, it may lie with the system manufacturer for defects in programming or hardware, or it may lie with the engineers who created the system for flaws in design.[16] And it may not be clear where in that web the blame out to lie. Further complicating this aspect is the possibility of malfunction due to enemy action, be it hacking, sabotage or damage.[17] Opponents of LAWS argue that this inability to define the chain of accountability renders the usage of these systems amoral.[18]

With the possibility of indiscriminate attacks on civilian by unaccountable systems, many opponents see their very existence as an affront to human dignity and the right to life. The Universal Declaration Human Rights states that all humans are "born free and equal in

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[14] Sharkey, "The Evitability of Autonomous Robot Warfare," 789–90.
[15] Etzioni and Etzioni, "Pros and Cons of Autonomous Weapons Systems," 75.
[16] Carol McCann and Ross Pigeau, "Clarifying the Concepts of Control and of Command" (Toronto, 1999), 14.
[17] Michael W. Byrnes, "Nightfall: Machine Autonomy in Air-to-Air Combat," *Air and Space Power Journal* 28, no. 3 (2014): 60.
[18] Sharkey, "The Evitability of Autonomous Robot Warfare," 791.

dignity and rights," with dignity referring to the intrinsic worth of a human being. When the value of a human is debased to a simple calculation by a machine, then humans are reduced to mere objects or mere variables in a mathematical equation.[19] Opponents argue that with humans removed from the loop and leaving a machine to make decisions about who lives and who dies directly goes against the principle of human dignity.[20]

Yet another concern surrounding the use of LAWS is the potential destabilising effect of a nation having the capacity to deliver lethal force without risking the lives of their own military personnel. This could reduce the political risks associated with initiating or becoming involved in conflict, which in turn could lower the threshold to start a war. Similarly, a system choosing when and how to apply lethal force without intervention from a human may result in unintended initiations of hostilities or unintentional escalation of hostilities once already begun. These two possibilities exist simultaneously as threats to both global peace and stability and to the ability of international bodies to manage conflicts.[21]

POTENTIAL BENEFITS

Based on the inability of LAWS to adhere to the principles of distinction and proportionality, and the inability to enforce accountability, these systems currently exist in a state of legal and ethical limbo which has yet to be decided upon. However, there are proponents of LAWS who argue that, despite potential technological challenges, the systems have the potential to behave more ethically than humans given that humans also do

[19] Aaron M. Johnson and Sidney Axinn, "The Morality of Autonomous Robots," *Journal of Military Ethics* 12, no. 2 (2013): 134; Jürgen Altmann and Frank Sauer, "Autonomous Weapon Systems and Strategic Stability," *Survival* 59, no. 5 (2017): 134.
[20] Slijper, "Where to Draw the Line? Increasing Autonomy in Weapon Systems – Technology and Trends," 6.
[21] Asaro, "On Banning Autonomous Weapon Systems: Human Rights, Automation, and the Dehumanization of Lethal Decision-Making," 692.

not always adhere to IHL. Others still go further, arguing that it is a moral imperative that LAWS be developed and employed in the battlefield sooner rather than later as they have the potential to reduce both civilian and combatant casualty rates.

The argument for LAWS rests upon the premise that the systems do not need to be perfect, but only need to be better than humans. Autonomous systems do not have any self-preservation instincts which may drive them to make rash decisions; they do not have emotions such as anger, fear, or frustration which can cloud judgement; they have no pre-conceived notions or biases which may cause them to ignore new information that differs what they might have expected; and they can process more data from more sources far faster than a human. Essentially LAWS could operate at super-human levels of cognition without mental or psychological degradation due to the fog of war.[22]

Additionally, like any unmanned system, LAWS are potential force multipliers. The US Department of Defense spent $850,000 per year for each soldier in Afghanistan. Conversely, some robots that can perform infantry-like functions cost as little as $230,000 per unit. The US Army estimates that autonomous systems could reduce the size of a battalion by one thousand soldiers with no loss of capability. Similarly, air forces could benefit from robotic pilots which do not fatigue, that can handle g-forces beyond the physiological limits of humans, and that could manoeuvre in a much more unpredictable fashion than manned aircraft rendering them harder to engage or defend against. The US Air Force estimates that a single autonomous aircraft could destroy an entire fleet of manned aircraft.[23] Again, LAWS could operate at super-human levels of performance and

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[22] Ronald C. Arkin, "The Case for Ethical Autonomy in Unmanned Systems," *Journal of Military Ethics* 9, no. 4 (2010): 333–34.
[23] Etzioni and Etzioni, "Pros and Cons of Autonomous Weapons Systems," 72–73.

endurance. And by removing the human from the loop, and therefore from the battlefield, the risk of combat casualties can be virtually eliminated.

These are very appealing arguments which can be quite convincing at face value: LAWS could theoretically make better decisions than humans while simultaneously outperforming them and keeping them out of harm's way. However, on closer consideration these positive attributes are not necessarily what they seem. While, computationally, computers can outperform humans, the battlefield is not an equivalent problem set to, say, driving a vehicle, flying an aircraft or playing chess. Applying pattern recognition and analysis to the decision of whether or not to apply lethal force does not meet the requirements for assessing distinction and proportionality, as this essay has already shown. But for sake of argument, let us assume that an AI system were able to make those calculations with greater accuracy than humans. Then by using that system to augment human decision-making (in- or on-the-loop), rather than to act autonomously, we would garner all of the benefits of the more discriminate application of lethal force while also maintaining human accountability. Similarly, unmanned or uninhabited vehicles that are operated remotely (again maintaining human in- or on-the-loop) would also garner the benefits of super-human performance with associated reduction in risk to the combatant. The so-called advantages of LAWS can still be achieved without the need to enter the ethically and legally murky realm described in the precious section.

THE WAY AHEAD

So if there are viable alternatives to take advantage of the benefits of AI on the battlefield without the ethical and legal disadvantages, there is no need to develop LAWS. Research and development into automated systems, AI, and unmanned/uninhabited systems

should continue, as should research and development into autonomous system *without* the ability to employ lethal force. That is where the line must be drawn. Machines should not have the power to make life-and-death decisions without a human in- or on-the-loop. However, to prevent the development and proliferation of these systems, the international community should ban them.

There are mechanisms through which the international community can enact a prohibition or restriction on the development and usage of LAWS. The United Nations (UN) Convention on Certain Conventional Weapons (CCW), initially adopted in 1980, includes five protocols which prohibit or restrict weapons such as mines, booby-traps, incendiary weapons, and blinding laser weapons.[24] Since 2013, LAWS have been the subject of discussion for a potential sixth protocol, but so far no census has been reached; however 19 countries do currently support a pre-emptive ban on LAWS.[25]

Discussions should continue in this forum, but the failure to reach consensus quickly is by no means in indication that the process of banning LAWS is not achievable or desirable. The CCW previously could not agree on the how to handle anti-personnel mines (now covered under CCW Protocol II), but those discussion led other members of the international community to work on an independent legal instrument which became the Ottawa Convention on Anti-Personnel Mines in 1997. Similarly, Non-Governmental Organizations (NGOs) led the charge for the banning of cluster munitions, yet another indiscriminate weapon system, in 2008. NGOs such as the ICRC, the Campaign to Stop

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[24] Government of Canada, "Convention on Certain Conventional Weapons," Convention on Certain Conventional Weapons, 2018, https://international.gc.ca/world-monde/issues_development-enjeux_developpement/peace_security-paix_securite/conventional_weapons-convention….

[25] Chris Jenks, "The Gathering Swarm: The Path to Increasingly Autonomous Weapons Systems.," *Jurimetrics: The Journal of Law, Science & Technology* 57, no. 3 (2017): 342–43.

Killer Robots, Mines Action Canada, and PAX are already pushing this agenda.[26] In 2015, at the International Joint Conference on Artificial Intelligence (IJCAI) over 3,000 leading AI researchers and scientists penned an open letter calling for "a ban on offensive autonomous weapons beyond meaningful human control."[27] At the 2018 IJCAI, over 2,400 roboticists and scientist again called upon governments around the world "to create a future with strong international norms, regulations and laws against [LAWS]," while simultaneously pledging to "neither participate in nor support [their] development, manufacture, trade, or use."[28]

Regardless through which means the international community reaches a prohibition on the development or deployment of LAWS, the international community should also undertake the establishment of an agency or organization to monitor and enforce that prohibition, akin to the International Atomic Energy Association and its role in enforcing the Nuclear Non-Proliferation Treaty.

CONCLUSION

Every so often, a new technology emerges which changes society forever. With respect to warfare, this first occurred with the advent of gun powder; then again with nuclear weapons; and now LAWS have the potential to radically alter the very nature of warfare itself.[29] AI and autonomous systems are not inherently bad, and in many ways they

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[26] Slijper, "Where to Draw the Line? Increasing Autonomy in Weapon Systems – Technology and Trends," 5–7; Asaro, "On Banning Autonomous Weapon Systems: Human Rights, Automation, and the Dehumanization of Lethal Decision-Making," 691; The Signal Board, "2018 : Decision Time for Canada on Killer Robots," 2019, 4; Boulanin and Verbruggen, "Mapping the Development of Autonomy in Weapon Systems," 2.

[27] Etzioni and Etzioni, "Pros and Cons of Autonomous Weapons Systems," 74.

[28] David Meyer, "Top AI Researchers - Including Elon Musk - Pledge to Never, Ever Help Anyone Make Killer Robots," Fortune, 2018, 2, fortune.com/2018/07/18/killer-robots-pledge/.

[29] Etzioni and Etzioni, "Pros and Cons of Autonomous Weapons Systems," 74.

have the potential to make warfare safer for civilians and combatants alike. However, the possibility of arming autonomous systems with lethal weapons has the potential to violate IHL while simultaneously reducing human beings to variables in equation and thereby eroding the concept of human dignity. Without the ability to ability to completely distinguish a civilian from a combatant and without the means to balance the loss of civilian lives against the pursuit of a military advantage, LAWS cannot exercise distinction or proportionality. Without a human-in-the-loop, or at least a human-on-the-loop, there is no one to hold accountable to illegitimate killings outside IHL. As such, LAWS represent an unacceptable ethical and legal risk to the human right to life.

Advocates of LAWS argue out that machines can act more reliably than humans under stressful situations, and that removing combatants from harm's way would reduce casualty numbers during hostilities. However, these gains can still be made without having to move all the way across the spectrum from unmanned/uninhabited to completely autonomous. To protect civilians and combatants alike from the indiscriminate lethality of LAWS, the international community must move to enact an outright ban on their development and deployment. An independent international agency should be established to monitor and enforce this ban to ensure that humans always have a role in the ultimate decision to take the life of another human being.

Technology evolves at an exponential rate, and autonomous technology is no different. Without taking appropriate action now, society risks facing a world where life-and-death decisions are being delegated to machines before having addressed the moral and legal implication of LAWS. Let us learn the lesson from the Manhattan Project and have

the debate now before the next revolution in warfare appear on the battlefield.[30] Canada, as a long-time leader in human rights, has also expressed interest in bolstering its leadership role in AI research.[31] It is time now to combine those two aspirating and join like-minded nations in prohibiting LAWS either through the CCW or through another independently-led treaty.

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[30] Johnson and Axinn, "The Morality of Autonomous Robots," 129.
[31] Erin Hunt, "Hunt: Where's Canada's Voice on Banning so-Called 'Killer Robots'?," *Ottawa Citizen*, March 29, 2018, 2.

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