National Defence Défense nationale

Canadian Forces College

Collège des Forces Canadiennes

CONTROLLED AUTONOMY : THE LIMITED FUTURE USE OF AUTONOMOUS WEAPONS

Major Gregory Owens

JCSP 44

Exercise *Solo Flight*

Disclaimer

Opinions expressed remain those of the author and do not represent Department of National Defence or Canadian Forces policy. This paper may not be used without written permission.

PCEMI 44

Exercice *Solo Flight*

Avertissement

Les opinons exprimées n'engagent que leurs auteurs et ne reflètent aucunement des politiques du Ministère de la Défense nationale ou des Forces canadiennes. Ce papier ne peut être reproduit sans autorisation écrite.

Canada

CANADIAN FORCES COLLEGE – COLLÈGE DES FORCES CANADIENNES

JCSP 44 – PCEMI 44
2017 – 2019

EXERCISE *SOLO FLIGHT* – EXERCICE *SOLO FLIGHT*

CONTROLLED AUTONOMY: THE LIMITED FUTURE USE OF AUTONOMOUS WEAPONS

Major Gregory Owens

CONTROLLED AUTONOMY: THE LIMITED FUTURE USE OF AUTONOMOUS WEAPONS

What was once considered science fiction, has become common place on today's battlefields. Unmanned drones, complex weapon systems able to automatically identify and engage targets are now core capabilities in the arsenals of many modern militaries.[1] Furthermore, with ever increasing advancements in robotics, sensory, and artificial intelligence domains, concepts for new technologies with military applications are constantly being explored, few of which are considered outside the realm of possibility. This has resulted in debates about if new capabilities *should* be developed rather that if a capability *can* be developed.

At the forefront of one such debate is the design, development and utilization of autonomous weapons systems, which are predicted by many to be the future of warfare.[2] Autonomous weapons are already in use today but their potential revolutionary role in the future of warfighting is being heavily contested amongst lobbyists, industries, lawyers, militaries, and state and non-state powers.[3] The ongoing debates on the future of autonomous weapons systems are primarily oriented around moral, legal, and command and control considerations with some calling for a complete ban of their development and use, while others advocate an, almost, unencumbered adoption of new capabilities.

Another contributing factor in the lack of a unified consensus on their utilization is that the term autonomous weapons systems is broadly defined. In general though, there exists different categories of autonomous weapons that are separated by the level of autonomy and

---

[1] Hammes, T.X., "Autonomous Weapons Are Coming, This is How We Get Them Right". *The National Interest.* 2 December 2018

[2] *Ibid.*

[3] Reeves, Shane R. and William J. Johnson. "Autonomous Weapons: Are You Sure Those Are Killer Robots? Can We Talk About It?" *The Army Lawyer*. April 2014. p25

degree of human control that is involved. It is this latter consideration, which is the cause of the most contention between the various stakeholders. It is also what will end up limiting the application of autonomous weapons systems in the future.

The purpose of this paper is not to embark in or evaluate the various arguments that exist regarding the future use of autonomous weapons. However, this paper will explore the moral, legal, and command and control considerations surrounding their use in order to show that, due to the desire to maintain human control, the future use of autonomous weapons systems will not be as revolutionary as predicted.

Autonomous weapons systems have been in service by militaries around the world for decades and their advantages in the battlespace are numerous.[4] They have the potential to reduce exposure of soldiers to high threat environments and they have the ability to operate in adverse conditions, where humans cannot.[5] Autonomous weapons systems also possess exceptional data processing capabilities and are able to react faster than human decision making. This is the main principle for many current defensive autonomous systems such as the Phalanx and C-RAM, which identify, target, and engage threats without any direct human involvement.[6] In addition, improving sensory capabilities have the potential to improve target identification and threat recognition, which ultimately reduces the possibility of human error.[7]

The many advantages to military applications of autonomous weapons systems are generally agreed upon within the international community and are not often debated. This

---

[4] Hammes, T.X., "Autonomous Weapons Are Coming, This is How We Get Them Right". *The National Interest.* 2 December 2018

[5] Etzioni, Amitai, and Oren Etzioni, "Pros and Cons of Autonomous Weapons Systems." *Military Review*, May/Jun 2017. p72

[6] Tarantola, Andrew. "Will we be able to control the killer robots of tomorrow?". *Engadget,* New York: AOL Inc., 2017

[7] Atherton, Kelsey D. "Are Killer Robots the Future of War? Parsing the Facts on Autonomous Weapons." *The New York Times Magazine*, 15 November 2018

indicates that their continued use and further development is inevitable. What is debated, however, is the degree to which autonomous weapons *should* be used, which revolves around the question of what exactly is an autonomous weapons system?

Unfortunately, there is no one accepted definition for autonomous weapons systems, which is one of the causes for debates on their current and future utilization. Most definitions, however, include systems that can independently select and attack targets.[8] Also, there are three generally accepted categories of autonomous weapons systems:

- Human-in-the-loop, which require direct human involvement in target selection and engagement, such as aerial drones;
- Human-on-the-loop, which are able to identify, target, and engage threats independently but maintain human oversight, such as the Phalanx; and
- Human-out-of-the-loop, which are able to attack without any human involvement. There are currently no human-out-of-the-loop weapons but it is the future development of weapons in this category that is causing the arguments on autonomous weapons systems.[9]

In addition, it is important to clarify that autonomous weapons are not the same as artificial intelligence.[10] Although artificial intelligence is a contributing factor in the development of autonomous weapons, they are unique areas of study, which focus on different capabilities.[11] Advancements in artificial intelligence are, however, a consideration for the future

[8] Noone, Gregory P. and Diana Noone, "The Debate over Autonomous Weapons Systems." *Case Western Reserve Journal of International Law 47 (2015)*. p27
[9] *Ibid.* p28
[10] *Ibid.* p27
[11] Franke, Ulrike. "Autonomous Weapons, AI are Future of Defence but Require Ethical Debate, Says Expert". Last Accessed 26 May 2019, https://www.euractiv.com/section/defence-and-security/interview/autonomous-weapons-ai-are-future-of-defence-but-require-ethical-debate-says-expert/

development and increased capabilities of autonomous weapons, especially for human-out-of-the-loop systems, as it deals directly with the decision making ability of machines.

So, the fundamental debate is not whether autonomous weapons should be used. Rather, the level of independent decision making by machines and the necessary amount of human oversight is at the actual heart of the controversy surrounding the use of autonomous weapons systems. Indeed, leaving life and death decisions completely in the hands of machines decision making poses a significant moral and ethical dilemma.

In fact, in 2015, many of the world's leading experts in artificial intelligence issued a call for a ban on offensive autonomous weapons beyond meaningful human control based on moral considerations. Similarly, other organizations, including the United Nations, have called for the prohibition of the development or utilization of lethal, fully autonomous weapons until an internationally agreed upon framework is established.[12]

Many of these objections toward the development of lethal autonomous weapons are based on the risks associated with ensuring proper target identification and minimizing collateral damage. These concerns are not unsubstantiated. For example, during a friendly fire incident in 1987 where the Aegis air-defense system on the USS STARK failed to identify a threat from an Iraqi fighter, which resulted in the deaths of 37 sailors. A few months later, during the same Iran-Iraq War, the Aegis aboard the USS VINCENNES, operating in semi-autonomous mode, misidentified and shot down an Iranian civilian airliner killing all aboard.[13] Although the Aegis system is only a semi-autonomous, or human-on-the-loop, system and both of these incidents

---

[12] Etzioni, Amitai, and Oren Etzioni, "Pros and Cons of Autonomous Weapons Systems." *Military Review*, May/Jun 2017. p75

[13] Noone, Gregory P. and Diana Noone, "The Debate over Autonomous Weapons Systems." *Case Western Reserve Journal of International Law 47 (2015)*. p32

were attributed to human error, they show that autonomous weapons systems may pose significant risks, even with an appropriate amount of human oversight.

Despite the evolving improvements in artificial intelligence, many believe that the risks associated with allowing machines more independence in making life and death decisions is just not something humanity should entertain. After all, acts of war are deemed to be justified based on their morality or immorality.[14] Removing humans from the decision making cycle would then make it virtually impossible to ensure the moral and ethical decisions are being made.

Interestingly, many of the arguments provided on moral grounds against the use of autonomous weapons systems, such as collateral damage and target identification, are also used as arguments in support of the increased use of autonomous weapons. Actually, proponents of further development argue that the potential for the reduction of soldier exposure to threats, the increase to target identification efficacy, the reduction collateral damage, as well as the reduction of risk for ethical infractions on the battlefield are all reasons why the development of more capable autonomous weapons systems is not only morally and ethically justified, but that society is essentially obligated to explore these possibilities.[15] It should also be noted that the arguments in support of the use autonomous weapons systems do not advocate the complete removal of human oversight.

So, it is evident that the level of autonomy of weapons systems cause a moral and ethical dilemma, which supports the need for a certain level of human control moving forward. The need to maintain human control is therefore considered as common ground regarding the use of

---

[14] Atherton, Kelsey D. "Are Killer Robots the Future of War? Parsing the Facts on Autonomous Weapons." *The New York Times Magazine*, 15 November 2018

[15] Etzioni, Amitai, and Oren Etzioni, "Pros and Cons of Autonomous Weapons Systems." *Military Review*, May/Jun 2017. p74

autonomous weapons; it is only the level of what should be considered acceptable that is being debated.

Along these same lines, there exists common accepted legal considerations surrounding the use of autonomous weapons systems. Specifically, that autonomous weapons systems must adhere to the Law of Armed Conflict; that is, the development and deployment of weapons must follow the principles of distinction, proportionality, humanity, and military necessity.[16] Also, there is a common agreement that anyone who commits an act against the Law of Armed Conflict must be held accountable.[17] However, autonomous weapons systems pose significant legal challenges based on these considerations, under existing domestic and international law.

First, although there has been an international call to prevent, or at least, limit the development of lethal autonomous weapons based on moral considerations, they are not necessarily illegal, as long as they are designed to adhere to the principles of the Law of Armed Conflict. So, there is currently no real legal grounds to prevent research and development in the area. Another, more significant, legal challenge is concerning legal accountability.

Existing domestic and international laws are primarily aimed at holding individuals accountable. The challenge with autonomous weapons, however, is in identifying who can be held responsible for decisions made by machines; after all, guilt is based on legal and not moral culpability.[18] This has resulted in ongoing debates on a variety of potentially liable groups and individuals. One such group, which is considered is the designers and manufactures of these systems themselves.

---

[16] Noone, Gregory P. and Diana Noone, "The Debate over Autonomous Weapons Systems." *Case Western Reserve Journal of International Law 47 (2015)*. p29
[17] *Ibid*. p31
[18] Beard, Jack M. "Autonomous Weapons and Human Responsibilities." *Georgetown Journal of International Law 45 (2014).* p643

For this group, there is a comparable precedent under current laws, in that manufactures are held accountable for their products in the event they have cause harm. However, guilt in these cases is dependent on proof of negligence during the design, manufacture, and/or distribution phases. Similarly, weapons manufactures are not held accountable for how their weapons are used on a battlefield.[19] Therefore, in the case of legal accountability for decisions made by machines, as longs as manufactures adhere to all legal obligations, ensure adequate testing and quality control procedures, as well as mitigate and disclose potential risks, establishing manufacturer's guilt would be extremely difficult under current laws.

Manufacturers are not the only group that is affected by the question of accountability regarding the use of autonomous weapons. At their foundation, these systems are tools of war and so the responsibilities of military personnel in their use are also considered. Here, there is another common agreement in that there is no question that individual military members must follow the Law of Armed Conflict.[20] With fully autonomous weapons, however, no military members are in involved in the actual decision of target engagement, so there can be no liable breach of the Law of Armed Conflict by any individual soldier. Also, even if the military members who plan for and authorize a mission or operation may ultimately be responsible for the outcome of any attacks, they could not be held accountable for needless civilian casualties of collateral damage unless these were maliciously intended.[21]

Fully autonomous weapons pose a challenge for command responsibilities as well. Command responsibility in a legal sense boils down to the fact that military commanders are fundamentally responsible for the acts of their subordinates and for failure to take appropriate

---

[19] *Ibid.* p645
[20] *Ibid.* p652
[21] *Ibid*. p654

action in order to prevent, or punish, any infractions against international laws.[22] Once again, under current legal frameworks, proving criminal negligence of a commander in relation to the acts committed by an autonomous system would be extremely difficult.

To summarize, existing legal frameworks are simply not adapted to deal with the possibility of fully autonomous weapons. This means that any consideration for the future development and use of these systems will need an expansion and clarification of laws, especially with respect to accountability for the use of autonomous weapons systems. The requirement to expand legal principles regarding accountability also implies that legal limitations will be imposed on the design, manufacture and use of lethal autonomous weapons in order to maintain some form of human control to assure accountability can be established.

In addition to legal considerations, command responsibility faces another challenge regarding autonomous weapons systems in that a commander is limited in their ability to "command" machines. In other words, with fully autonomous systems, a commander would have no real way to ensure that these systems would consistently act in a desired manner in order to achieve specific objectives. This is especially true given the constantly changing conditions a battlefield and throughout a campaign. Command responsibility is not something that will ever be overlooked when discussing military capabilities and it is for that reason that, even in the absence of formal international governance, national policies are being put in place. For example, the United States Department of Defense has stated that autonomous weapons systems will not replace humans on the battlefield but will continue to be used to minimize the exposure of soldiers to threatening tasks.[23] So, the keys of a nation's war machine (literally in this case)

---

[22] *Ibid.* p657

[23] Noone, Gregory P. and Diana Noone, "The Debate over Autonomous Weapons Systems." *Case Western Reserve Journal of International Law 47 (2015)*. p32

will never be completely turned over to autonomous systems or, in other words, humans will never be completely out of the decision making loop.

Finally, states are not only looking to establish their own policies on the future of autonomous weapons systems but they are also working with the international community with respect to their global governance. The really good news is that these discussions are taking place before these new-age weapons have been fielded and that they do not only include nation states but also the industrial and scientific communities. In addition, historic lessons from previous revolutionary weapons, such as nuclear and chemical weapons, are being considered in establishing an international regulatory framework.[24] Future international regulations pertaining to autonomous weapons systems will become the primary mechanism to limit the technological possibilities that exist.[25]

In conclusion, this paper has argued that autonomous weapon systems will not become as revolutionary in the future of warfare as some predict, primarily because of the need to maintain human control.

Autonomous weapons are not new and many, with varying degrees of autonomy, have been in use by militaries around the world for decades. These systems have many advantages and continue to evolve, which will inevitably lead to their continued use and further development.

Despite, or perhaps more appropriately because of, these advantages and the potential for future capabilities, autonomous weapons systems are heavily debated. These debates are not regarding the use of autonomous technologies, per se, but rather in defining the appropriate level of human control that is needed. The arguments surrounding the level of autonomy to be given to

---

[24] Etzioni, Amitai, and Oren Etzioni, "Pros and Cons of Autonomous Weapons Systems." *Military Review*, May/Jun 2017. p78
[25] *Ibid.* p77

"killer robots" center around moral and ethical considerations as well as legal debates regarding the challenges with their use under current laws, especially in terms of accountability. Also, questions with respect to a commander's ability to actually "command" machines exist as well. In all cases, though, the need to maintain some form of human control is clear, which is what will ultimately ensure that human-out-of-the-loop systems will never be fully unleashed to their full technological potential.

Furthermore, unlike in cases of previous revolutionary weapons, international regulatory discussions are taking place before these weapons exist. Eventually, these talks will lead to regulations and treaties, presumably similar to those for nuclear weapons, for the design, development, and use of autonomous weapons systems, which will become the primary mechanism to limit their future capabilities and applications.

Moving forward, the underlying need to maintain human control will limit the "decision making" ability of the machines used in war. So, although autonomous weapon systems will continue to evolve, they will not revolutionize the way that wars are fought.

Bibliography

1. Atherton, Kelsey D. "Are Killer Robots the Future of War? Parsing the Facts on Autonomous Weapons." *The New York Times Magazine*, 15 November 2018

2. Beard, Jack M. “Autonomous Weapons and Human Responsibilities.” *Georgetown Journal of International Law 45 (2014)*:617-681

3. Etzioni, Amitai, and Oren Etzioni, “Pros and Cons of Autonomous Weapons Systems.” *Military Review*, May/Jun 2017

4. Evans, Hayley and Natalie Salmanowitz, “Lethal Autonomous Weapon Systems: Recent Developments.” *Lawfare*. 7 March 2019

5. Franke, Ulrike. “Autonomous Weapons, AI are Future of Defence but Require Ethical Debate, Says Expert”. Last Accessed 26 May 2019, https://www.euractiv.com/section/defence-and-security/interview/autonomous-weapons-ai-are-future-of-defence-but-require-ethical-debate-says-expert/

6. Hammes, T.X., “Autonomous Weapons Are Coming, This is How We Get Them Right”. *The National Interest.* 2 December 2018

7. McCormick, Ty. “Lethal Autonomy: A Short History”. Last Accessed 26 May 2019, https://foreignpolicy.com/2014/01/24/lethal-autonomy-a-short-history

8. Newton, Michael A. “Back to the Future: Reflections on the Advent of Autonomous Weapons Systems.” *Case Western Reserve Journal of International Law 47 (2015):* 5-23

9. Noone, Gregory P. and Diana Noone, “The Debate over Autonomous Weapons Systems.” *Case Western Reserve Journal of International Law 47 (2015):* 25-35

10. Reeves, Shane R. and William J. Johnson. “Autonomous Weapons: Are You Sure Those Are Killer Robots? Can We Talk About It?” *The Army Lawyer*. April 2014: 25-31

11. Salmanowitz, Natalie, “Explainable AI and the Legality of Autonomous Weapon Systems.” *Lawfare*. 21 November 2018

12. Surber, Regina. “Artificial Intelligence: Autonomous Technology (AT), Lethal Autonomous Weapons Systems (LAWS) and Peace Time Threats.” *ICT4Peace Foundation*. 21 February 2018

13. Tarantola, Andrew. “Will we be able to control the killer robots of tomorrow?”. *Engadget,* New York: AOL Inc., 2017