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THE CHALLENGES CREATED BY AUTONOMOUS SYSTEMS AND ARTIFICIAL INTELLIGENCE

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ABSTRACT

This paper examines the challenges created by autonomous systems on the ethical, legal, command and strategic domains. The employment of autonomous systems challenges our current frameworks for holding people accountable for decisions that are made and result in battlefield atrocities. New responsibility practices will have to be defined that can hold accountable those involved in design, manufacture, programming, employment, and oversight. Ethical and legal issues abound, centered on the application of International Humanitarian Law and its principles that are not easily applied to lethal autonomous systems. There is a central question that must be addressed concerning the legality of removing humanity from lethal decisions. The command domain will also be challenged with requirements for new competencies, applications of authority, and new concepts of responsibility required to command autonomous forces. Lastly, there will be strategic challenges created by autonomous systems. The application of just war theory becomes ever more complex and the accompanying challenges to democratic principles underpinning just war theory and International Humanitarian Law could cause leaders to increasingly resort to conflict to settle differences. Attempts to implement control regimes will also meet with significant challenges due to the difficulty in defining autonomy and the dual use nature of its technology. Traditional control regimes are unlikely to address the threat of autonomous systems and their proliferation to state and non-state actors. The strategic threat created by autonomous systems and artificial intelligence could undermine global stability plunging the world into a global arms race and period of great insecurity.

The introduction of unmanned systems to the battlefield doesn't change simply how we fight, but for the first time changes who fights at the most fundamental level. It transforms the very agent of war, rather than just its capabilities.

- P.W. Singer, 2009[1]

Victory smiles upon those who anticipate the changes in the character of war, not upon those who wait to adapt themselves after the changes occur.

- General Giulio Douhet, 1921[2]

INTRODUCTION

Military technology is ever evolving and there has been a steady increase in the lethality, range and capabilities of weapons used in conflict. This has simultaneously increased the resulting damage and lethality of war. As Vivek Sehrawat, in his work on lethal autonomous weapons, outlines this upward spiral of devastation is "far beyond what any club bearing ancestor could have imagined."[3] What has changed in this spiral is the increasing removal of the human element from the conduct of war through the use of unmanned systems. Since the commencement of the global war on terror, there has been a marked increase in the use of unmanned weapons systems to support conventional forces and conduct strikes where it has been undesirable or impossible to deploy human forces.

As Elinor Sloan identifies, this introduction of remote-controlled systems that have been specifically designed to conduct lethal actions in combat begins to raise ethical and legal issues concerning their employment. What has mitigated these challenges is

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[1] P.W. Singer, *Wired for War: The Robotics Revolution and Conflict in the 21st Century* (New York: Penguin Press, 2009), 194.

[2] Giulio Douhet, *The Command of the Air,* trans. Dino Ferrari (New York: Coward-McCann, 1942; reprinted Washington, DC: Office of Air Force History, 1983), 30.

[3] Vivek Sehrawat, "Autonomous Weapon System: Law of Armed Conflict (LOAC) and Other Legal Challenges," *Computer Law & Security Review* 33, Issue 1 (2017): 3, https://ssrn.com/abstract=2962760.

that there has always been a human in the command loop who authorises lethal action. However, this is being challenged by the development of autonomous systems using artificial intelligence to make lethal targeting decisions.[4]

It has been predicted by some contributors to the literature surrounding this topic, that this is a move towards the "…industrialization of warfare towards a factory of death and clean-killing where hi-tech countries fight wars without risk to their own forces."[5] Those taking a less alarmist approach champion autonomous systems as the ultimate step in reducing the potential harm to nations armed forces and suggest autonomous systems will herald in an age of moral warfare, conducted by machines that will not fall victim to emotion, misunderstanding, poor decisions and thus cannot commit war crimes.[6]

The discussion surrounding autonomous systems, especially lethal autonomous systems (LAWS) is topical with a recent Convention on Conventional Weapon meeting of a Group of Government Experts in Geneva, in November of 2017. The discussion is being fuelled by Non-Governmental organizations such as the Campaign to Stop Killer Robots, and the International Committee on Robotics Arm Control who seek to ban all LAWS before they are developed.[7]

Despite this outcry by concerned groups of experts in the fields of robotics, artificial intelligence, machine learning, and arms control specialists, many nations are

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[4] Elinor Sloan, "Robotics at War," *Survival* 57, no. 5 (2015): 107, doi:10.1080/00396338.2015.1090133

[5] Noel Sharkey, "The Evitability of Autonomous Robot Warfare," *International Review of the Red Cross* 94, no. 886 (2012): 788, doi:10.1017.S1816383112000732.

[6] Ronald C. Arkin, "The Case for Ethical Autonomy in Umanned Systems," *Journal of Military Ethics* 9, no. 4 (2010): 333, doi:10.1080/15027570.2010.536402.

[7] Frank Sauer, "Stopping 'Killer Robots': Why Now is the Time to Ban Autonomous Weapons Systems," *Arms Control Today* 46, no. 8 (2016), 8, https://www.armscontrol.org/ACT/2016_10/Features/Stopping-Killer-Robots-Why-Now-Is-the-Time-to-Ban-Autonomous-Weapons-Systems.

still striving forward with research and development projects to develop autonomous systems. The US and UK are both pursuing autonomous aerial combat vehicles, South Korea is fielding autonomous sentry robots, and ground forces of many western nations are researching autonomous ground robotic weapons.[8] What is most striking about the development of autonomous systems is that the vast majority of the research is being conducted in the private sector for civilian applications; their military applications require only minor alterations. It is clear that autonomous systems are quickly leaving science fiction to soon become reality.

The challenges created by autonomous system are legion and require a significant discussion as they impact some of our most strongly held ethical beliefs. These in turn challenge existing legal structures both national and international. Not simply a replacement for the human on the battlefield, autonomous systems could be considered the next revolution in military affairs and will have a significant impact on how forces are commanded. Autonomous systems and artificial intelligence are not simply tactical weapon systems and will create strategic pressures that will have to be addressed across the international community.

This paper will examine these challenges created by autonomous systems including artificial intelligence. Firstly it will examine the ethical and legal challenges created by the development and employment of autonomous systems examining topics such as defining autonomy, the issues of moral agency, international humanitarian law, and legal responsibility. Then it will look at how autonomous systems will impact on the

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[8] Christof Heyns, "Report of the Special Rapporteur on Extrajudicial, Summary, and Arbitrary Execution, United Nations Human Rights Council." *23rd Session,* 9 April 2013, A/HRC/23/47: 9, https://documents-dds-ny.un.org/doc/UNDOC/GEN/G13/127/76/pdf/G1312776.pdf?OpenElement

command domain and examine how it will challenge current conceptual understandings of what commanding autonomous forces will mean using the command framework recognized by the Canadian Armed Forces focussing on competency, authority and responsibility. Finally it will look to examine the strategic challenges created by autonomous systems that affect the international community as a whole in addition to those States who wish to employ them. This will include the concept of just cause, impacts on the democratic principle, and the issue of control regimes.

This is a survey paper, it does not attempt to provide solutions to these challenges, instead its purpose is to identify the complexity of the discussion that needs to take place before Canada and the Canadian Armed Forces look to develop and employ these systems.

SECTION 1 - ETHICAL AND LEGAL CHALLENGES

Understanding Autonomy

In order to examine the challenges introduced by autonomous systems, it is first important to understand autonomy. NATO Allied Command Transformation (ACT) has produced a military centric analysis of autonomy. They define autonomous systems as one that is capable of transforming higher-level intent and direction into actions that achieve that intent. It requires the ability to integrate sensing, perception, analysis, communication, planning, decisions making and action to achieve goals defined by human operators or another system with which it is interlinked[9]. As Williams outlines, a significant challenge of autonomy is that it can only be conceptualized in relation to conditions that exist externally to the system. It is not a property of the system such as its weight, colour or size.[10]

Tim McFarland, a researcher in the Asia Pacific Centre for Military Law at the Melbourne Law School proposes a complimentary understanding of autonomy. Rather than focussing on the technical requirements for autonomy, McFarland suggests that autonomy is a capability that represents and defines the relationship between an operator and a machine. It is built into the system and enables the system to execute tasks normally executed by a human operator.[11] Autonomy enables the expression of human will manifested via the programming in the systems controller. Understanding autonomy is understanding the delegation of tasks to the controller and understanding the

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[9] Andrew P. Williams, "Defining Autonomy in Systems: Challenges and Solutions," in *Autonomous Systems: Issues for Policy Makers*, ed. Andrew P. Williams and Paul D. Scharre. (The Hague, Netherlands: NATO Communications and Information Agency, 2015), 33.

[10] Ibid., 52.

[11] Tim McFarland, "Factors shaping the legal implications of increasingly autonomous military systems," *International Review of the Red Cross* 97, Issue. 900, (2015): 1324, doi:10.1017/S1816383116000023

relationship between the human operator and the machine.[12] As Scharre points out, autonomy in its most basic definition is the ability of a machine to perform a task without human input. Using his simple explanation, an autonomous weapon system would be the combination of an un-crewed armed platform and a degree of autonomy, the ability to assess and respond to the environment around it in accordance with guiding instructions.[13]

Assessing Autonomy

What must be first understood is that autonomous systems are not a discrete category of systems; machines are not simply autonomous. Instead autonomy must be understood as capability within a system that exists on a continuum of control ranging from total human control to total computer control.[14] There have been a number of attempts to create taxonomy for the range of autonomy within a system, a difficult though required task. It is difficult due to the complexity surrounding autonomy, and required to understand autonomy and its implications for defence systems and legal challenges.[15]

Scharre proposes that autonomy is really a term used to describe three different concepts; the relationship between the human and the machine in the control loop, the level of sophistication exhibited by the machine while decision making, and the nature of the decision being made.[16] McFarland supports this argument stating that to truly understand the nature of autonomy exhibited by a machine, four facets must be examined. These are the degree of control the machine possesses, the way tasks are

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[12] Ibid., 1325.

[13] Paul D. Scharre, "The Opportunity and Challenge of Autonomous Systems," in *Autonomous Systems: Issues for Policy Makers*, ed. Andrew P. Williams and Paul D. Scharre. (The Hague, Netherlands: NATO Communications and Information Agency, 2015), 8.

[14] Williams, "Defining Autonomy in Systems…", 37.

[15] Ibid., 40.

[16] Scharre, "The Opportunity and Challenge…", 9.

allocated between an operator and a machine, that autonomy will vary by the function being executed, and that it will vary by circumstance in which those functions are executed.[17]

One of the most complex aspects of defining or scaling autonomy is that this will change over time due to a number of factors. Most systems will be an aggregate of systems and subs systems, each of which may possess varying levels of autonomy.[18] Rather than aggregating the overall score of autonomy, it is more important to understand the ethical and legal implications of each of those sub systems and their role in any action.[19] As Scharre argues "it is meaningless to refer to a machine as 'autonomous' or semiautonomous' without specifying the task or function being automated."[20] He goes on to argue that there will never be a machine that is *fully autonomous*, instead it is more valuable to discuss the autonomous functions of systems. The complexity of defining the level of autonomy in a system is further complicated as the nature of autonomy will vary according to the evolution of tasks, mission complexity, and the circumstances experienced by the system. [21] A US department of Defense Defence Science Board Task Force study recently concluded that at any stage of a mission, autonomous systems may occupy multiple levels of autonomy simultaneously, thus a multi-facetted framework is required that assesses autonomy across the allocation of cognitive functions and responsibilities between the machine and operator, how this evolves with mission phasing, and the inherent design choices made in the system creation.[22]

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[17] McFarland, "Factors Shaping the Legal…", 1323.
[18] Ibid., 1321.
[19] McFarland, "Factors Shaping the Legal….", 1321.
[20] Scharre, "The Opportunity and Challenge…", 11.
[21] McFarland, "Factors Shaping the Legal…", 1322.
[22] Williams, "Defining Autonomy in Systems…", 52.

Ethical Challenges

Behaviour on the Battlefield

The employment of autonomous systems can be argued to significantly alter the ethical behaviour of forces on the battlefield. In his argument supporting the use of autonomous lethal systems on the battlefield, Ronald C. Arkin, a leading robotocist and advocate for autonomous systems, suggests that autonomous systems will perform better than human combatants have. This becomes a de facto argument mandating the development and employment of autonomous systems. To the extent that societies desire to constrain unethical behaviour in warfare, autonomous systems are the solution to this and thus must be pursued.[23]

Arkin argues that autonomous systems will lack the harmful emotions that humans experience in combat situations and thus will be immune to revenge motives, fear, rage, anger, and frustration. These are the key emotions that trigger unlawful acts on the battlefield.[24] Arkin cites a US Surgeon General report on Operation IRAQI FREEDOM in which major ethical violations of by US soldiers were examined. These offences include mistreatment of non-combatants, modification of ROEs to accomplish mission objectives, a broadly held belief in the use of torture, a failure to report unethical behaviour, and a rejection of the concept of treating non-combatants with dignity and respect.[25]

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[23] Ronald C. Arkin, "The Case for Ethical Autonomy in Unmanned Systems," *Journal of Military Ethics* 9, no. 4, (2010): 333, doi:10.1080/15027570.2010.536402

[24] Ibid.

[25] Ibid., 335.

Arkin argues that these incidents and beliefs occur due to the human factor, the instability and irrationality inherent in humans due to emotion. He argues that they have always been a part of warfare and will likely remain as they are result of human emotions. He further argues that the situation will continue to degrade due to the continued introduction of technology into the modern battlefield. The modern battlefield is not only much more lethal, the use of modern technology has created an emotional disengagement between the war fighter and their target, reducing that interpersonal relationship required to achieve humanitarian empathy.[26] Arkin states that " the price is that technology, while increasing the ability to kill, decreases 'the awareness that dead human beings were the end product'".[27] This would be eliminated with the use of ethical autonomous systems, as they would be immune to the emotional and mental trauma of the battlefield.

This argument is opposed by Ryan Tonkens, a postdoctoral research fellow at Novel Tech Ethics, Dalhousie University. One of Tonkens' key arguments is that the emotional state of the combatant is only one of many factors that can result in battlefield atrocities. These can include system malfunctions, poorly or vaguely defined mission goals, flawed rules of engagement, corruption in command structures, none of which will be corrected by autonomous systems no matter how ethically constrained their behaviour is.[28] He also suggests that unethical behaviour can result from misemployment of autonomous systems by the force commander or human operator overseeing

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[26] Ian Kerr and Katie Szilagyi, "Evitable Conflicts, Inevitable Technologies? The Science Fiction of Robotic Warfare and IHL," *Law, Culture and the Humanities*, 2014, 34, doi:10.1177/1743872113509443.

[27] Arkin, "The Case for Ethical Autonomy…", 336.

[28] Ryan Tonkens, "The Case Against Robotic Warfare: A Response to Arkin," *Journal of Military Ethics* 11, no. 2, (August 2012): 158, doi:10.1080/15027570.2012.708265.

employment. These key actors are not free from emotional responses. This can result in unethical use of ethically limited autonomous systems by ethically unlimited humans beings.[29]

Tonkens counters the common argument that autonomous systems will avoid unethical behaviour by bringing technological superiority in the realm of identification to the battlefield. This argument supposes that the range of sensors and data links that can be applied to autonomous systems are so much more advanced than human senses, that misidentification of targets will be almost eliminated.[30] Tonkens' counter argument cuts to a logical fallacy of this argument, namely that it is not misidentification of targets that underpins most war crimes, instead immoral behaviour on the battlefield stems from the belief that targeting non-combatants is morally acceptable.[31]

Tonkens introduces other facets concerning the employment of autonomous systems. Where as Arkin argues that autonomous systems are immune to unethical behaviour, Tonken counters that they are also constrained from morally exceptional behaviour. The loss of the human factor on the battlefield also removes the humane aspect of combat, the expressions of compassion, restraint, kindness, sacrifice that form heroic behaviour.[32]

Moral Agency

One of the most significant arguments surrounding the ethics of autonomous systems is whether a machine can be ethical, can it possess morality or is it simply

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[29] Ibid., 157.
[30] Arkin, "The Case for Ethical Autonomy…", 333.
[31] Tonkens, "The Case Against Robotic Warfare…", 155.
[32] Ibid., 151.

expressing predetermined morality? This is an important discussion, as the outcome will aid in assigning moral agency to autonomous systems. This will have implications in whether these systems are able to meet the requirements of International Humanitarian Law (IHL) and in how responsibility is assigned when unethical or illegal acts are committed.

Aaron Johnson and Sidney Axinn in the Journal of Military Ethics argue that machines cannot be considered moral agents as humans are as they cannot give themselves moral commands, they can simply follow moral commands or replicate programmed moral acts.[33] This does not transfer morality to the machine; autonomous systems are simply executing the morality prescribed to it by its creators and programmers. Their support for this argument is that moral decisions are based upon the possession of values and values are informed by sacrifice. As autonomous systems cannot possess a notion of sacrifice, they cannot possess values; they therefore can only follow the values of their programmers.[34]

Arkin supports this view and states that moral agency is irrelevant. He argues instead that we should be able to build ethical imperatives into autonomous systems. His concept is to impose an *ethical governor* on autonomous system behaviour. This approach supposes that the laws of armed conflict and rules of engagement can be coded into ethical constraints based on deontological and utilitarian logic systems.[35] It is Arkin's belief that a protocol can be designed that will capture ethical principles and be

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[33] Aaron M. Johnson and Sidney Axinn, "The Morality of Autonomous Robots," *Journal of Military Ethics* 12, no. 2 (2013): 135, doi:10.1080/15027570.2013.818399.

[34] Ibid.

[35] Ronald C. Arkin, "Governing Lethal Behaviour: Embedding Ethics in a Hybrid Deliberative/Reactive Robot Architecture, Georgia Institute of Technology GVU Technical Report GIT-GVU-07-11, S. 1-177." (2007): 39.

consistently acted upon by autonomous systems just as humans would do. In this case autonomous systems would not need to be full moral agents, as their behaviour can be constrained into ethical choices. [36]

Robert Sparrow, a philosopher who tackles the ethics and morality of autonomous systems, states that Arkin's argument is fundamentally flawed as the deontological and utilitarian frameworks that he relies upon are "still poorly understood and often highly contested"[37] by ethical philosophers. Sparrow argues that the system of ethics that Arkin relies upon are extremely complex and context dependent, and require high levels of abstraction to be realised. Sparrow further argues that in order to create an ethical system there must be an understanding of meaning, as "ethics is a realm of meanings".[38] Sparrow argues that a moral agent must be able to understand the nature of its actions, it must be able to conduct ethical reasoning. In the context of autonomous lethal systems which will kill human beings, a moral agent would have to understand the difference between killing as murder, killing in self defence, and killing as a legal action in an armed conflict. The example of murder further requires an understanding of intention, rights, and the meaning of murder as an evil act. Sparrow argues that Arkin's approach will fail to achieve this as meaning of murder transcends rules and must be understood in a moral and emotional context. This requires the autonomous system to possess full moral agency. [39]

The requirement for moral agency is of specific interest when IHL, or the doctrine of *jus in bello*, is considered. Sparrow contends that the very basis of IHL and the laws of

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[36] Ibid., 40.

[37] Robert Sparrow, "Robots and Respect: Assessing the Case Against Autonomous Weapon Systems." *Ethics & International Affairs* 30, no. 1 (2016): 104, doi:10.1017/S0892679415000647.

[38] Ibid., 105.

[39] Ibid.

armed conflict (LOAC) rely on the establishment of an interpersonal relationship between the actors on the battlefield. He cites Thomas Nagel's influential work on warfare and morality, *War and Massacre*, which argues that conflict between agents in war must be aimed at each other as subjects not as a response to a situation. In essence action taking against another person must be a deliberate action, which creates a relationship between those involved. This relationship between the object and subject of violence is critical in Nagel's view to establishing the morality of the action.[40] Sparrow contends that this respect for the moral humanity of combatants is a key injunction of IHL and this interpersonal relationship is critical to the principles of discrimination and proportionality. The act of killing someone on the battlefield requires not just acknowledging why they can be considered combatants, but more importantly "in granting the possibility that they might have a right not to be subject to direct attack by virtue of being a non-combatant one is acknowledging their humanity".[41] Johannes and Axinn argue in support of this belief. They suggest that giving an autonomous system the ability to decide to kill a human being, abandons the concept of human dignity, it denigrates the status of humans to objects. This, they contend, violates the Universal declaration of Human Rights 1949, Article 1 which states "all humans are born free and equal in dignity and rights".[42]

The ethical approach argued by Arkin, that ethics can be codified and coded into any system rejects the requirement for moral agency and as such renders all actions taken by those systems as reactions to a situation following Nagel's argument. This is exactly

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[40] Thomas Nagel, "War and Massacre," *Philosophy and Public Affairs* 1, No. 2 (Winter ,1972): 136, Accessed from http://philosophyfaculty.ucsd.edu/faculty/rarneson/Courses/Nagelwarandmassacre.pdf.

[41] Sparrow, "Robots and Respect: Assessing the Case…", 112.

[42] Johnson and Axinn, "The Morality of Autonomous…", 134.

the contrary to what Sparrow, Johannes, and Axinn argue is required as the moral underpinning of the IHL. Arkin's ethical system acts without morality and this violates the LOAC. The Canadian Armed Force doctrine on LOAC recognizes the humanitarian principle as a fundamental principle and states "Military necessity must always be compatible with respect for the human person. Even in armed conflict, there are certain basic human rights that must be respected".[43] This would support the arguments above that delegating the ability to kill a human being to autonomous systems that lack moral agency violates the accepted understanding of humanity and human rights and would violate the Laws of Armed conflict. Unless Canada fundamentally alters its approach to IHL and the LOAC, the issue of moral agency will have to be addressed prior to fielding of autonomous systems.

Moral Agency and Responsibility

The issue of moral agency is key in the establishment of moral responsibility for actions and their consequence. As Merel Noorman, a member of the Royal Netherlands Academy of Arts and Science's e-Humanities Group, argues, assigning moral responsibility establishes a link between the actors in a situation, ascribing a subject; those committing the act, and an object; those people or things having an act committed upon them.[44] This reinforces Nagel's concept of the requirements for moral conflict and creates the start of a responsibility framework used to judge how conflict is conducted.

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[43] Department of National Defence, B-GJ-005-104/FP-021, *Law of Armed Conflict: At the Operational and Tactical Levels* (Ottawa: DND Canada, 2003), 2-2.

[44] *Stanford Encyclopedia of Philosophy*, s.v. "Computing and Moral Responsibility," *by Merel Noorman,* last accessed 6 December 2017, https://plato.stanford.edu/archives/win2016/entries/computing-responsibility/.

In contemporary combat, there is always a human in the command loop, someone has to make a decision to take a human life or allow a human life to be taken. Military members who violate the laws of armed conflict are held accountable for their actions, however the challenge is holding an autonomous system accountable for unethical behaviour. As Noorman points out, many critics of AWS contend that the use of fully autonomous systems will create actors on the battlefield which humans will not be able to control, understand, or predict their behaviour.[45] Noel Sharkey, an emeritus professor of artificial intelligence and robotics at the University of Sheffield and the Chair of The International Committee for Robot Arms Control, argues that the very nature of these systems will create a long causal chain that defies current responsibility practices. Those included in this chain are the manufacturer, the defence agency that defined the requirements and oversaw procurement, the programmers, the designers, the engineers involved in its construction, the operator involved in the operation, those that designed and commanded the military operation.[46]

Noorman counters these critics by arguing that responsibility practices are ever evolving and the ongoing introduction of technology to the battle space has already created responsibility frameworks and practices that have evolved from a direct causal relationship. Noorman contends that responsibility practices within sociotechnical systems, systems relying on interaction between people and technology, are complex with tasks distributed across multiple human actors and technical systems.[47] The actions

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[45] Merel Noorman, "Responsibility Practices and Unmanned Military Technologies," *Science and Engineering Ethics* 20, no. 3 (2104): 811, doi:10.1007/s11948-013-9484-x.

[46] Noel Sharkey, "Saying No to Lethal Autonomous Targeting," *Journal of Military Ethics* 9, no. 4 (2010): 380, doi:10.1080/15027570.2010.537903.

[47] Noorman, "Responsibility Practices…", 812.

of these complex systems are governed by operational interests, policies, regulation and legislations and these instruments are in turn developed by politicians, inspectors, managers, financiers, and command functions. When accidents occur the cause can be due to a multitude of factors such as outside influence, design error, operator mistake, negligence, faulty maintenance or a combination of the above.[48] These interdependencies in sociotechnical systems can significantly constrain the individual's ability to be in control or understand the outcome of their actions. They may not see the effect of their actions down the causal chain, and their actions are subsequently impacted by decisions made down the chain, just as their possible actions are limited by decisions made up the chain from their position.[49]

Noorman uses the current unmanned aerial vehicle (UAV) systems operated by the US military in strike roles as an illustrative example. The modern UAV operation relies on a large number of people and systems scattered across the globe. The UAV can be launched in a theatre by a ground support crew, operated by a crew back in the US mainland, with sensor data that is being routed through and analyzed by specialists in fusion centres around the world. The decision to strike is often taken by political leaders in capitals far from the theatre of operation.[50] Noorman outlines how this has required the renegotiation of previous responsibility practices. UAV operations have not supplanted a person in an existing operational context, instead the introduction of this technology has changed human activities and decision making processes across a sociotechnical network. This broad change to activities and arrangements has modified expectations on individual

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[48] Ibid.
[49] Ibid., 813.
[50] Noorman, "Responsibility Practices and Unmanned…", 816.

behaviour and accountability between those in the system. As Noorman states "The negotiations about the various aspects of responsibility practices are, thus, part of the processes of mutual shaping between technology and society."[51]

Current responsibility practices may prove insufficient for autonomous systems, however they are also evolving as new technology, policies and external factors influence them. Autonomous systems represent a new external influence that will drive renegotiation of extant responsibility practices and a redefinition of responsibility and accountability will have to be developed that addresses the challenge.

Backwards facing responsibility practices, such as incident investigations, focus on understanding the actions taken and choices made stemming from an incident. Nyholm and Smids identify a challenge created by autonomous systems during these processes, namely that the system did not make a decision; the decision was actually made during the design and creation of the autonomous system, in what they refer to as the planning phase of design. It is then and only then they contend, that the moral framework for future actions is decided.[52] This contention is based upon the proposition that machines cannot choose, they are only carrying out programming, the decisions were made when that programming was designed. This is supported by McFarland when he argues that this programming that directs behaviour is a result of decisions made during design. He states "the expression of that person's will was merely waiting within the systems memory for the previously determined trigger to be detected."[53]

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[51] Ibid., 821.

[52] Sven Nyholm and Jilles Smids, "The Ethics of Accident-Algorithms for Self Driving Cars: an Applied Trolley Problem," *Ethical Theory and Moral Practice* 19, no. 5, (2016): 1280, doi:10.1007/s10677-016-9745-2.

[53] McFarland, "Factors Shaping the Legal…", 1327.

Noorman argues that negotiations of responsibility frameworks must take place on multiple levels across all facets of the communities involved. In the development of autonomous systems, this will require inputs from elected officials, government agencies, civil society organisations, academic researchers, legal organisations and the broad public. Stakeholders involved in the design, manufacture, acceptance and operation of an autonomous vehicle (AV) need to negotiate the conditions for the introduction and operation of AVs on the roads. This is forward looking responsibility and surrounds the questions of programming and societal responsibility.[54] These are the stakeholders that must be part of the negotiation, and it must be understood that these stakeholders have competing interests.[55] The manufacturer of autonomous systems cannot be the sole agent responsible for the determination of ethical frameworks; instead the alignment of moral algorithms with human values requires a collective discussion to establish acceptable ethical behaviour for autonomous systems. The values underlying desired behaviour are societal values and this discussion represents a societal requirement.[56]

As manufactures continue to develop systems capable of making life or death decisions, such as the identification of valid targets and taking of lethal action, the responsibility and accountability framework around this will need to be updated.[57] Thus responsibility practices surrounding the use of autonomous systems need to acknowledge if a machine can make a decision, and if not how are those who make decisions in the planning phase of autonomous system design held accountable.

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[54] Nyholm and Smids, "The Ethics of Accident-Algorithms…", 1284.
[55] Ibid., 1281.
[56] Jean-Francois Bonnefon, Azim Shariff, and Iyad Rahwan, "The Social Dilemma of Autonomous Vehicles," *Science* 352, no 6293 (2016): 3, accessed at https://pdfs.semanticscholar.org/8523/20e33132442e1c335b13b88be0f7afa3c080.pdf.
[57] Noorman, "Responsibility Practices and Unmanned…", 823.

Determining What is Right and Wrong

If responsibility practices are to be continually refreshed and negotiated in reaction to the introduction of new technology, one challenge that will have to be addressed is in defining the ethical basis to guide machine programming. Autonomous systems force all involved to revisit current norms and values to address this question.

One of the major challenges facing AVs, which is equally relevant to military applications, is that an autonomous system may have to face an ethical dilemma. Although the accepted belief is that autonomous vehicles will render roads much safer by eliminating the human from the control loop, the challenge is created when following the very well codified rules of the road is not enough. There will be situations where the AV will be unable to avoid an accident, and in these situations an ethical decision must be made as to where to distribute unavoidable harm. Bonnefon et al, argue that distributing harm is a moral decision and thus the algorithms that will control the actions of autonomous vehicles must have embedded moral principles.[58]

As Patrick Lin points out, if autonomous systems must take action resulting in human harm then an autonomous system must be made responsible for decision making.[59] In Lin's study of autonomous cars he identifies that this is called crash optimization, the result should be the crash with the best outcome. However he rightfully identifies that in order to create such a process, the result is something akin to military

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[58] Bonnefon, Shariff, and Rahwan, "The Social Dilemma of Autonomous…", 2.

[59] Patrick Lin, "Why Ethics Matters for Autonomous Cars," in *Autonomous Driving*, ed. Maurer M., Gerdes J., Lenz B., Winner H. (Berlin: Springer, 2016), 71, https://doi.org/10.1007/978-3-662-48847-8_4.

targeting.[60] The creation of an algorithm that assesses what the best outcome of a crash would be must first be based upon an ethical foundation such as utilitarianism or egoism. These competing philosophies would focus on protecting the greater good, or doing the least harm, and protecting the owner or occupants at all costs. It must then be given instructions or criteria that translate this imperative into conditions it can assess. Finally it must be given assessment factors to analyze the best course of action, this could include the assignment of value to people and items. This would empower the system with the ability to respond in a situation with what should be appropriate action. This is not something that can be ignored; instead it is argued that we must program autonomous system with these capabilities, that to do anything else would be "an unacceptable omission in its readiness to deal with the realities and contingencies of [the real world]".[61] We have a moral duty to impose control on what happens in dangerous environments, such as traffic. The moral duty is to ensure that events happen in good and justifiable ways, failing to attempt this is a moral failing.

The question of owner responsibility must be addressed. When a person or company, or government purchases an autonomous systems, it must be determined what responsibility they assume at the moment of purchase. As Lin identifies, by choosing an autonomous vehicle that operates on a utilitarian approach the owner is agreeing to certain choices. The most significant is that the occupant may be sacrificed to save a greater number of lives. This is a decision taken by human drivers on the roads every day, however turning this decision over to a machine means it is taken without the situational consent or the owner. The algorithm makes this decision instead, essentially dooming the

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[60] Ibid., 72.
[61] Nyholm and Smids, "The Ethics of Accident-Algorithms…", 1278.

occupant without your agreement. As Lin states "…there is an astonishing lack of transparency and therefore consent in such a grave decision, one of the most important that can be made about one's life—perhaps noble if voluntary, but criminal if not."[62] This is another issue that modernized responsibility frameworks will have to address.

Legal Challenges

As previously outlined, autonomy is created when tasks normally executed by humans are instead executed by machines. Assessing autonomy in a system is a complex process requiring those involved to understand the nature of the task being replaced, the degree of control exercised by the machine, and the changing nature of the task and control relationship over time. Autonomous systems provide advantages in the nature of endurance, speed, persistence but do not fundamentally change the way the task is carried out. It is not the activation of a weapon system that is novel, human operators do that as well, it is the nature of the process that leads up to that activation that is new.[63] The legal challenges raised with autonomous systems focus on this transference of decisions. It must be determined if law binds the decisions and actions that have been transferred to the autonomous system and if there are legal obligations inherent in those actions. If legal obligations for decisions and actions undertaken by an autonomous system are attributed to responsible persons, a key question is: are these people specified in the existing legal framework? Finally, if human operators are held responsible for the legal obligations of autonomous systems it must be determined if they are occupying a role contemplated by

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[62] Lin, "Why Ethics Matters…", 77.
[63] McFarland, "Factors Shaping the Legal…", 1325.

the relevant laws.[64] From a legal perspective, McFarland argues that humans will never be removed from the control of autonomous systems, the nature of this control has simply evolved. Designers, programmers and hardware developers will make choices that affect future behaviour of the system, commanders will choose to employ the system in an operational theatre and mission planners will place limitations on missions that constrain the behaviour of systems.[65]

As Bostrom and Yudkowksy identify in their work on artificial intelligence and algorithms, as these tools begin to replace humans in control loops or take on the management of aspects of society, there is a requirement for transparency. As AI and algorithms take over cognitive work that has a social dimension, they inherit the same social requirements human executing that work would, this means there has to be an ability to oversee and inspect the process while underway. In addition to the requirement for transparency, Bostrom and Yudkowsky also identify a requirement for these systems to be predictable. They link this requirement to the legal principle of *stare decisis* and argues that, while this is a legal norm, it certainly isn't an engineering norm. Engineers who will design AI and autonomous systems will likely avoid the requirement for predictability, they argue, as it restricts the ability to leverage ever-evolving technology.[66] This requirement for predictability and transparency will factor greatly in the subsequent section concerning the command domain.

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[64] McFarland, "Factors Shaping the Legal…", 1326.
[65] Ibid.
[66] Nick Bostrom and Eliezer Yudkowsky, "The Ethics of Artificial Intelligence," in *The Cambridge Handbook of Artificial Intelligence*, ed. Keith Frankish and William M. Ramsey (Cambridge University Press, Cambridge, 2014), 317.

The fielding of autonomous weapon systems brings very specific legal issues. These will first be examined in the realm of international humanitarian law, or the laws of armed conflict. Subsequently this paper will look at civil and criminal law related challenges posed by autonomous systems.

Laws of Armed Conflict

In studying Autonomous systems in relation to International Humanitarian Law (IHL) or otherwise known as the Law of Armed Conflict (LOAC) there are two aspects, firstly the legality of the weapons themselves, *the means*, and whether the systems can respect IHL in the conduct of their function, *the methods*.[67] In order to assess the legality of the means, the ICRC relies on Article 36 of the Additional Protocol I of the Geneva Conventions, the issues related to methods will be examined through the principles of distinction and proportionality.

Article 36 of Additional Protocol I

There is the fundamental question of whether countries party to the Geneva Convention can even use such weapons. There is a legal requirement under Article 36 of the Additional Protocol I to the Geneva Conventions that states should evaluate new weapons systems to ensure they are in compliance with international Law.[68]

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[67] Sehrawat, "Autonomous Weapon System…", 2.

[68] Office of the Judge Advocate General. "Protocol Additional to the Geneva Conventions of 12 August 1949, and Relating to the Protection of Victims of International Armed Conflicts (Protocol I) – 1977," in B-GG-005-027/AF-022, *Law of Armed Conflict: Collection of Documents*, ed. Canadian Forces Military Law Centre (Ottawa: DND, 2011), 147.

This article is interpreted differently by many nations however it is viewed by the International Committee of the Red Cross (ICRC) as a legal obligation on all states.[69] Many countries including the United States have accepted this viewpoint and conduct legal review on new weapons.[70] Canada has not taken the same position instead stating that it will "review procedures concerning the development or acquisition of new weapons, means and methods of warfare."[71] This leaves the CAF in a position where it recognizes the legal requirement for Article 36, however the government has not taken a formal position on its application. However that should not stop the CAF from undertaking legal reviews. As Sherewat suggests, in order to meet to the intent of Article 36, any autonomous systems should undergo a legal review in order to identify functions or capabilities that would challenge its ability to meet the requirements of LAOC. Once identified the legal review should determine and set out any limitations on their employment.[72]

Principles of Discrimination and Proportionality

Two of the most significant principles that any combatant must adhere to in the LOAC are the principles of distinction and proportionality. The deployment of autonomous systems mandates that these issues be resolved. The LOAC demands that a

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[69] International Committee of the Red Cross Geneva, "A Guide to the Legal Review of New Weapons, Means and Methods of Warfare: Measures to Implement Article 36 of Additional Protocol I of 1977," *International Review of the Red Cross* 88, no. 864 (2006), 933, https://www.icrc.org/eng/assets/files/other/irrc_864_icrc_geneva.pdf

[70] Bonnie Docherty, *Losing Humanity, The Case against Killer Robots,* (Human Rights Watch, 2012), 22, https://www.hrw.org/sites/default/files/reports/arms1112ForUpload_0_0.pdf.

[71] International Committee of the Red Cross, "A Guide to the Legal Review…", 934 note 8.

[72] Sehrawat, "Autonomous Weapon System…", 22.

target be positively identified as a legitimate target and that the minimum amount of force is used to achieve objectives and respond to threats.[73]

The Principle of Distinction requires that a combatant only target other combatants or belligerents. Discrimination is likely the most complex task faced by lethal autonomous weapons (LAWS). They must be able to distinguish between parties to the conflict and all others such as civilians, children, aid workers, wounded combatants, surrendered combatants, civilian and military assets.[74] Without this ability, autonomous systems would fail to meet the basic tenets of international law and their use in warfare could be considered unjust.[75] The International Committee of the Red Cross also highlights that the principle of distinction requires the combatant to identify between valid military objectives and targets and civilian objects, which are non-targetable unless they become valid military objectives.[76] This means that any autonomous system employed justly on the battlefield must possess a capability to achieve this level of distinction or it will commit actions that violate international humanitarian law.

This will require solutions involving both sensors and cognitive analysis. However this is complicated by the lack of clear definitions in international humanitarian law such as the 1949 Geneva Convention and the 1977 Protocol I. The 1949 Geneva Convention relies on the use of common sense to determine combatants from non-combatants.[77] The 1977 Protocol I is more specific but defines civilians using a negative

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[73] Johnson and Axinn, "The Morality of Autonomous…", 132.

[74] Braden R. Allenby, "Are new technologies undermining the laws of war?," *Bulletin of the Atomic Scientists* 70, no. 1 (2014): 23, doi:10.1177/0096340213516741.

[75] Tonkens, "The Case Against Moral…", 160.

[76] International Committee of the Red Cross, "Rule 1. The Principle of Distinction Between Civilians and Combatants," last accessed 7 December 2017, https://ihl-databases.icrc.org/customary-ihl/eng/docs/v1_cha_chapter1_rule1.

[77] Sharkey, "Saying 'No!' to Lethal…", 379.

approach, stating what a civilian is not, a combatant rather than defining what a civilian is. It is the latter, Sharkey argues, that requires programmers to build a targeting algorithm.[78] On the modern battlefield there are many actors, from uniformed combatants, to insurgents, to civilians protesting against military action, the clues available to humans to discern valid targets from others are subtle and contextual. Sharkey states, "humans understand one another in a way that machines cannot".[79]

Sparrow cites some of the challenges an autonomous system will face with discrimination on the modern battlefield. It is not simply a matter of equipping a system with sensors and reasoning capabilities to identify armed people on the battlefield. Using the current conflict in Afghanistan as an illustrative example, there are many armed civilians in the country which are not party to a conflict, in many parts of the world carrying weapons is a matter of honour, with no intent to use them.[80] Further challenges identified by Sparrow would be decommissioned military equipment used as monuments and museum pieces, neutral forces in combat zones, or naval forces transiting through a region. Using simple discrimination models such as relying on the presence and possession of weapons or recorded weapon system profiles for example, these could be identified as combatants. Sparrow argues that context is required to determine true military targets and the ability to place the actions of a possible target into context requires a high level of judgement.[81]

The principle of proportionality requires that a combatant use the least amount of force required achieving its goals and it must seek to minimize loss of life and damage to

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[78] Ibid.
[79] Ibid.
[80] Sparrow, "Robots and respect…", 9.
[81] Sehrawat, "Autonomous weapon system…", 14.

property. The principle of proportionality requires a subjective balancing act that occurs in the human brain to make appropriate decisions. The LOAC do not lay out clear or unequivocal guidelines on proportional use of force, it is by necessity a judgement call.[82] A judgement has to be made between the advantages gained by a military action compared to the cost incurred by carrying out a strike. This would require the assignment of non-subjective values to human life, including all combatants and non-combatants, property, and the value associated with achieving the military goal. This non-subjective, non-contextual approach conflicts with the intent of the principle of proportionality, which requires a human subjective assessment to be conducted in the moment, and is inherent in the command function.[83] The value of action versus inaction and the advantage gained by an action all are assessments that must be taken in the moment.[84]

LAWS employed by the Canadian Forces must adhere to our own understanding and application of the Laws of Armed Conflict. This is set out in the Judge Advocate General manual the *Law of Armed Conflict at the Operational and Tactical Level* where the primary concept of humanity is recognized, as are the principles of LOAC discussed here. This concept forbids "the infliction of suffering, injury or destruction not actually necessary for the accomplishment of legitimate military purposes."[85] This confirms the requirement for discrimination, proportionality and the immunity from harm for civilians.

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[82] Sharkey, "Saying 'No!' to Lethal…", 380.
[83] Sehrawat, "Autonomous weapon system…", 15.
[84] Sharkey, "Saying 'No!' to Lethal…", 380.
[85] Department of National Defence, B-GJ-005-104/FP-021, *Law of Armed Conflict…*, 2-1.

Options Presented by Domestic Law

The application of domestic law presents options to ensure the development and use of autonomous systems meet the legal and moral standards for the society. Although legal responsibility and moral responsibility are not the same, there is a significant overlap. There is no common or singular moral theory in any society and the generally accepted moral principles make it difficult to assign responsibility from a moral perspective.[86] However the situations where legal and moral acceptability align vastly outnumber those situations where they disagree. Legal systems become the arena in which issues of responsibility and agency are examined and determined. This means that meeting the needs of legal responsibility will go a long way to meeting moral responsibility, and can be used as a framework for the development of autonomous systems from a moral perspective.[87]

Peter Asaro suggests that robots can be regulated via the principles of *product liability*, as they are in essence commercial products. Additionally as they gain more sophisticated abilities and approach human level functions, then the issues of *agency* arise that include the aspects of *diminished responsibility*. Corporate punishment is also examined as it could form a basis of punishment for non-human entities.[88]

If autonomous systems are looked at as products, then Anglo-American civil law can be applied as a basis to hold manufacturers accountable for their actions or impact. This could include *negligence* if the manufacturer is found to have failed to adhere to

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[86] Peter Asaro, "Robots and Responsibility from a Legal Perspective," in *Proceedings of the 8th IEEE 2007 International Conference on Robotics and Automation*. (Rome, 2007), 1, last accessed 7 December 2017. http://www.peterasaro.org/writing/asaro%20legal%20perspective.pdf..

[87] Ibid.

[88] Ibid.

moral or legal requirements. If the manufacturer knew of problems or deficiencies and failed to inform their clients, then a *failure to warn* occurred. As well, a manufacturer could be found negligent if they fail to address dangers or risks that were easily foreseeable, this is a *failure to take proper care*.[89] However Hammond identifies that there are challenges with this approach, as it would require the victims of these weapons to initiate lawsuits against the manufacturer.[90] This would very difficult for victims in a warzone to do in Canadian courts of law.

The determination of responsibility is framed as liability. Liability can be apportioned if there are multiple stakeholders involved and the liability surrounding an issue can be apportioned across at varying levels. In the case of LAWS, this could mean the manufacture bears some liability, however the military employing it could also be found to bear some of the responsibility. What is important is that the law already identifies that "various factors and parties contribute differentially to some event".[91] Another key facet of liability apportionment to the manufacturer is that it will be difficult to hold manufacturers liable for the actions of a system that is designed to possess independent decision-making abilities. They are designed to exceed their initial programming through machine learning, the gaining of experience by each unit will alter the ability to attribute liability away from the manufacturer.[92]

The law recognizes that a user inherently accepts some risk in using a product. The nation that employs autonomous systems has to identify what those risks are, which

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[89] Ibid., 2.

[90] Daniel N. Hammond, "Autonomous Weapons and the Problem of State Accountability," *Chicago Journal of International Law* 15, no. 2, Article 8 (2014): 666.

[91] Asaro, "Robots and Responsibility…", 2.

[92] Hammond, "Autonomous Weapons…", 667.

risks are inherently accepted and how that affects liability for the manufacturer.[93] In the case of LAWS, this leads to state liability, actions that are conducted by organs of the state, such as the military, are attributable to the state. A military that operates LAWS will be accepting liability for these systems and passing that liability to the state.[94]

Punishment of Autonomous Systems

The use of civil law to determine legal responsibility and assign liability is a valid method of guiding moral development and use of autonomous systems. This may be the only solution, as criminal law cannot be effectively applied to autonomous systems. The first challenge is that criminal law requires moral agency in the person that is to be punished. As Asaro identifies, "Without moral agency, there can be harm, but not guilt" and "only a moral agent can be reformed". [95] Although a court may one day determine that autonomous systems, especially AI may attain the status of moral agency, it becomes a challenge to punish or imprison such an entity, which subsequently means deterrence is also challenged.

Summary

This section started out examining the concept of autonomy, how it is defined and assessed. Key lessons identified are that autonomy can only be understood in terms of the relationship between a human and the machine, autonomy exists on a continuum, it is complex and varies over time throughout the execution of tasks.

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[93] Asaro, "Robots and Responsibility…", 2.
[94] Hammond, "Autonomous Weapons…", 668.
[95] Asaro, "Robots and Responsibility…", 4.

The paper then reviewed the argument which supposes that autonomous systems are free from human emotion and thus will be more moral combatants. It was shown that: the current use of remotely operated weapons systems are already beginning to disengage the war fighter from the emotion of the battle space; there is contention if LAWS will be the next evolutionary step; and this will actually curb violations or increase this trend towards dehumanizing the battle-space.

One key challenge that will have to be addressed will be the issue of moral agency and whether autonomous systems can be attributed with it, and whether moral agency is required for legal use of LAWS. This is the foundational concept that must be addressed before the other ethical issues can be addressed. It can be argued that IHL relies on the concept of humanity within its application. Without moral agency, an autonomous system cannot meet the requirement of respecting human dignity embedded in IHL. Without it LAWS could be considered illegal weapons under the LOAC.

The issue of responsibility was also examined. The requirement to hold someone accountable for the commission of crimes is a critical aspect of domestic and international law. As the paper outlined, the increased complexity of socio-technological societies have already begun to develop distributed responsibility frameworks that could lend themselves to the employment of LAWS. It is argued that the days of simple causal connections in the battle space have long expired, current conduct of war involves a vast web of people and systems that are interlinked to support the war fighter.

This being said, there are still challenges created by autonomous technology, namely the requirement for any autonomous system to be both transparent and predictable to enable proper oversight and investigations. However, the very technology

that is being explored, the use of machine learning and artificial intelligence are both inherently unpredictable and difficult to understand.

Determining an acceptable moral framework that will be programmed into any autonomous system will also challenge current policies. This will need to be a discussion across multiple stakeholders and cannot be driven by the state nor the manufacturer alone. Instead this is a complex issue with multiple valid viewpoints that will have to be incorporated into regulation and policy. This is also a cornerstone challenge as it will be necessary to resolve this issue before a successful foundation of policy and regulation can be developed. There is a moral duty to create this foundation before these systems can be employed.

Before addressing the legal challenges centered on the principles of proportionality, discrimination and military necessity enshrined in the LOAC, there must first be an assessment of the legality of autonomous weapons under the Article 36 requirement. Once this is satisfied, there must be great effort put into analysing any potential system to be able to conduct itself in accordance with the LOAC. Finally, there needs to be an assessment of current domestic consumer law and its relevance to the sale and operation of autonomous systems. Any failure of a lethal autonomous system in a battle space may carry with it violations of domestic law and enable nations to hold manufacturers responsible; this will also require the state to look at the issue of state liability and what risk they assumed by employing these weapons. Not only will there be a requirement to hold people or systems accountable for failures or negligence, there must be a way to punish those found guilty.

SECTION 2 – CHALLENGES TO THE COMMAND DOMAIN

Command will still be required with the employment of Autonomous Units. A human commander will still make decisions on where and when to employ the units, the nature of their tasks and the length of their deployment.[96] However the exact nature of that command will face significant pressures from the employment of LAWS and AI. The current CAF theory on command relies largely on the work of Pigeau and McCann. Their reconceptualization of command and control, written in 2002, has guided the way CAF leadership approach the command domain.

Pigeau and McCann posit that command can only be carried out by humans as only humans possess the required attributes required for command. These are: the innovative thinking required for creative problem solving; the ability to accept responsibility for success or failure; and, the ability to motivate subordinates to raise their performance from adequate to outstanding.[97] Although they state this is self evident, autonomous systems and AI may challenge that assumption. In order to assess the impact of autonomous technology on the command domain, this paper will use the three dimensions of command capability proposed by Pigeau and McCann; Competency, Authority, and Responsibility, as a framework for discussion.

Competency

Competency refers to the skills and abilities a leader will require to exercise command and is broken down into four sub-categories; physical, intellectual, emotional

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[96] Douglas S. Lange, Phillip Verbancsics, Robert Gutswillwer and John Reeder, "Command and Control of Teams of Autonomous Units," in *17th International Command and Control Research and Technology Symposium*. (Fairfax, VA, 2012), 1, http://www.dtic.mil/get-tr-doc/pdf?AD=ADA570196.

[97] Ross Pigeau and Carol McCann, "Re-Conceptualizing Command and Control," *Canadian Military Journal* 3, no.1 (Spring 2002): 54, http://www.journal.forces.gc.ca/vo3/no1/doc/53-64-eng.pdf.

and interpersonal.[98] The sub-category most challenged by autonomous technology will be intellectual. The introduction of any new technology always brings with it a requirement to understand how best to employ and exploit it; autonomous technology now introduces entirely new fields of study to the future commander. A recent US Department of Defense (DOD) directive has clearly outlined the various departments requirement to certify that commanders of autonomous systems are:

> …trained in system capabilities, doctrine, and [tactics, techniques, and procedures] in order to exercise appropriate level of human judgement in the use of force and employ systems…in accordance with the law of war, applicable treaties, weapon system safety rules…and to ensure operators and commanders understand the functioning, capabilities, and limitations of a system's autonomy…[99]

Although this may seem simple with a cursory review, the implications are significant. A commander must make a subjective decision to order the use of LAWS in battle. This requires the commander to have both a technical understanding of the system, but also an understanding of the subjective values programmed into it when designed. If the programming can be altered to reflect the current battle-space, the commander must make the decision on what those alterations should be. If the system cannot be altered, then the commander has the responsibility to determine if the system can perform lawfully in the situation it will be placed.[100]

Peter Szegedi argues that the issue of competency takes on deeper significance in his analysis of UAVS and their impact on military leadership. He outlines the requirement for the modern military commander to have knowledge of specific military

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[98] Pigeau and McCann, 'Re-Conceptualizing Command and Control…", 58.

[99] Department of Defense, *Directive 3000.09: Autonomy in Weapon Systems* (21 November 2012), 11, http://www.esd.whs.mil/Portals/54/Documents/DD/issuances/dodd/300009p.pdf.

[100] Micheal N. Schmitt and Jeffrey S. Thurnher, "'Out of the Loop': Autonomous Weapons Systems and the Law of Armed Conflict," *Harvard National Security Journal* 4, (2013): 267, https://ssrn.com/abstract=2212188.

technology and the scientific skills required for their application. In the modern military environment these technological options now include remotely operated systems and will soon likely include autonomous systems. This means to command, you must understand the technology you are responsible to coordinate and integrate.[101]

Szegedi adds to the competency burden by illustrating the complexity created by the fielding of highly technological systems, namely immediate obsolescence. Due to the current rate of technological advancement, even the most up to date systems still include outdated and obsolete aspects. These are multigenerational systems that are common due to the cost and evolution of technology. The unique aspects of multigenerational systems require different operational concepts for their employment.[102] When this approach is applied to LAWS, a commander will require the knowledge of how friendly and belligerent systems will interact, where the offsets are and what opportunities will be created when they clash. The difference between past technological leaps forward and LAWS is the ability of self-evolution. Past commanders could understand the technological details that affected employment as they were predictable. Although upgrades may change the weapon, the effects and output are still predictable; LAWS equipped with AI and machine-learning capabilities are self-evolving, they rewrite their code based on experience, this means they are unpredictable.[103]

As outlined by Alberts and Hayes of the Command and Control Research Program, one of the fundamental tasks of the command domain is monitoring and

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[101] Peter Szegedi, "UAVs and The Military Leadership," *Scientific Research And Education In The Air Force - AFASES* 2, (2017): 185, doi:10.19062/2247-3173.2017.19.2.26.

[102] Ibid., 184.

[103] Markus Wagner, "The Dehumanization of International Humanitarian Law: Legal, Ethical, and Political Implications of Autonomous Weapon Systems," *Vanderbilt Journal of Transnational Law* 47, (2014): 1404, https://ssrn.com/abstract=2541628.

assessing the execution of a plan. Those in command must be able to recognize that forces are deviating from declared intent and take measures to realign their effort.[104] This is made ever more challenging by the unpredictable nature of LAWS employed with machine learning. This requires a new and challenging competency which commanders must possess.[105] Peter Margulies, Professor of Law at the Roger William University School of Law further defines this requirement by suggesting that to meet the competency requirements laid out above, a future commander of autonomous systems must possess specialized scientific knowledge such as machine learning, which is a complex scientific field, to be able to understand and predict behaviour of self-learning machines.[106] This results in future commanders having to possess significant technical and scientific knowledge in addition to the military arts in order to be considered competent.

Authority

Authority is the second dimension of the command model proposed by Pigeau and McCann and it is here that the real danger posed by autonomous command is outlined. Authority can be broken down into legal authority and personal authority. Legal authority is assigned by external sources, it is established by laws, orders and delegations of authority that formally assign a commander a mission and the resources to achieve it. Personal authority is more informal and is the authority given to a commander by peers

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[104] David S. Alberts and Richard E. Hayes, "Command and Control," in *The Future of Command and Control: Understanding Command and Control,* 31-48. (Washington, D.C.: Command and Control Research Program, 2006), 43.

[105] Szegedi, "UAVs and the Military…", 185.

[106] Peter Margulies, *Making Autonomous Weapons Accountable: Command Responsibility for Computer-Guided Lethal Force in Armed Conflicts*, Roger Williams Univ. Legal Studies Paper No. 166, (Roger Williams University School of Law, 21 February 2016): 20, https://ssrn.com/abstract=2734900.

and subordinates, it is based upon perceptions of competency combined with demonstrated ethics and values and is built over time.[107]

The employment of autonomous forces does not change the nature of legal authority, a human commander will still need to be assigned a mission, be given the resources to achieve it and this will be formalised through control structures. However, a commander of autonomous systems will never achieve a level of personal authority, as machines cannot bestow this upon a commander. As Pigeau and McCann identify, "Command authority is most effective with both legal authority to formalize power, and personal authority to motivate will in others."[108] However, there is no need to motivate autonomous systems, formal authority is all that is required. This eliminates one aspect of Pigeau and McCann's definition of command, the expression of creativity and will, the expression of will is no longer required as complete authority is now granted through programming.

Responsibility

Responsibility is the third dimension of command outlined by Pigeau and McCann. This dimension assesses an individual's willingness to accept legal and moral liability inherent in command. Responsibility has two aspects, extrinsic and intrinsic responsibility. Extrinsic responsibility represents the obligation to accept the control and accountability of superior authorities. Although responsibility can be delegated to subordinates, they must accept it for extrinsic responsibility to exist.[109] Intrinsic

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[107] Pigeau and McCann, "Re-Conceptualizing Command and Control…", 59.
[108] Ibid.

[109] Pigeau and McCann, "Re-Conceptualizing Command and Control…", 59.

responsibility is self-generated, and is the measure of commitment to the military mission. It relies on the resolve and motivation of those in command to commit to success.[110]

One aspect of extrinsic responsibility that is embodied in international law is the concept of command responsibility, which is the premise that a commander can be held criminally responsible for the actions of those under their command. This liability is based upon the premise that a commander failed to take the actions required by International Humanitarian Law (IHL). This includes not taking the appropriate precautions or measures to prevent subordinates from committing war crimes and not punishing those that have.[111] The commander is not charged with the crime of their subordinates, instead they are held responsible for a failure of duty to exercise command. Charges under the principle of command responsibility require a level of complicity in the act, a criminal act by a subordinate must be committed and there must be a form of acquiescence by those in command. It is this acquiescence by which the commander assumes legal responsibility for their failure. The acquiescence requirement centers on the fact that a commander knew about, or ought to have known about, the criminal conduct, had the power to prevent or punish it and failed to do so.[112]

Autonomous systems create a challenge in determining what a commander ought to have known, specifically, what constitutes this knowledge. Autonomous system behaviour has already been flagged as complex, and difficult to understand, especially when leveraging artificial intelligence and ethical control systems relying on machine

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[110] Ibid.
[111] Sehrawat, "Autonomous Weapon Systems…", 23.
[112] Jack M. Beard, "Autonomous Weapons and Human Responsibilities," *Georgetown Journal of International Law* 45, no. 3 (2014): 656, https://www.law.georgetown.edu/academics/law-journals/gjil/recent/upload/zsx00314000617.PDF.

learning. Simply understanding the complex technical specifications of a system, which requires an advanced technical understanding, may not support operational supervision requirements, just as a biology manual doesn't provide a basis for tactical supervision of soldiers. Instead there is a requirement for predictability to enable a commander to "know" what their forces are about to do.[113] Further, the complexity of autonomous systems and their employment on a battlefield will challenge the ability to link the actions that led to murder of civilians to system failure or personnel misconduct.[114]

A challenge to any complex socio-technical system is that accidents can occur without significant mechanical or human failure; instead they are the result of cascade of small, sometimes innocuous, technical and human errors. This is known as normal accidents theory and posits that that accidents must be looked at as normal in a system approach.[115] The normal accidents theory when applied to autonomous systems would suggest that war crimes could be construed as normal. This is clearly unacceptable and thus a framework for analysis and responsibility is required to govern acceptable employment of autonomous systems. Knowing that these cascade failures could occur at any time, especially in complex systems, operating in complex environments with complex interactions, a control structure must be established to enable a commander to both understand what is occurring, but also guide decisions on employment before and during an operation. Without such a control structure, it will be exceptionally difficult to assess if the commander had sufficient knowledge of autonomous system use and misuse

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[113] Chantal Grut, "The Challenge of Autonomous Lethal Robotics to International Humanitarian Law," *Journal of Conflict & Security Law* 18, no. 1 (2013): 19, doi:10.1093/jcsl/krt002.

[114] Beard, "Autonomous Weapons and Human Responsibilities…", 659.

[115] Bart Van Bezooijen and Eric-Hans Kramer, "Mission Command in the Information Age: A Normal Accidents Perspective on Networked Military Operations," *Journal of Strategic Studies* 38, no. 4 (2015): 454, doi:10.1080/01402390.2013.844127.

to determine and apply criminal liability. This leads to the argument to establish an autonomous system employment framework that will guide future commanders and provide a mechanism to assess legal responsibility for their actions or non-action. [116]

Command Intent

Mission command is the doctrinal leadership approach encouraged for use by the Canadian Armed Forces for operational execution and the concept of command intent is a critical aspect of modern mission command. Canadian Forces leadership doctrine states "…commanders articulate a 'commander's intent' to enable subordinates to understand the overall vision or broad objective…to determine how best to achieve a specific mission."[117] Keith Stewart in his analysis of mission command outlines that command intent is an often-confusing concept that relies on achieving a common understanding between the commander and the subordinate to succeed.[118] Pigeau and McCann identified that commander's intent is gained through explicit and implicit means. Commanders will explicitly state their intent via formal tools such as written or verbal orders but rely quite heavily on an implicit understanding by their subordinates of what they intend.[119] The ability of a subordinate and superior to establish implicit understanding relies on a myriad of societal factors, which include the interpersonal competency of the leader and levels of personal authority, gained along the command structure.[120] As stated by Schaefer, Evans

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[116] Beard, "Autonomous Weapons and Human…", 659.

[117] Department of National Defence, A-PA-005-000/AP-005, *Leadership in the Canadian Forces: Leading People* (Ottawa: DND, 2007), 6.

[118] Keith Stewart, "Mission Command: Problem Bounding or Problem Solving," *Canadian Military Journal* 9, no. 4 (2009): 55, http://www.journal.forces.gc.ca/vo9/no4/09-stewart-eng.asp.

[119] Pigeau and McCann, "Establishing Common Intent: The Key to Coordinated Military Action", in *The Operational Art, Canadian Perspectives: Leadership and Command,* ed. Allan English (Kingston: Canadian Defence Academy Press, 2006), 92.

[120] Pigeau and McCann, "Re-Conceptualizing Command and Control…", 59.

and Hill "Mission command will be exercised with respect to robotic technology – such technology will be used to accomplish the commander's intent and desired end state."[121]

The introduction of LAWS into a mission command environment will challenge commanders' ability to achieve the implicit intent currently relied upon to enable mission command. It is clear that commanders of autonomous systems will have to; communicate intent to these systems, ensure that the system understands this intent, and have the ability to monitor compliance with the intent.[122] However, as identified by Pigeau and McCann, the majority of that intent is unstated, this requires both the autonomous systems and their commander's to develop abilities to bridge the human-machine gap and develop implicit understanding. This requirement for achieving implicit understanding reinforces the argument for commanders to have a competency in machine learning and artificial intelligence outlined above. However, there will also be a requirement for the systems themselves to be party to the establishment of common ground with their human counterparts. As Schaefer et al. identify, "this will include shared mental models, shared goals, and a shared understanding of the world so that communication and action are mutually understood and expected."[123]

Autonomous Command

Pigeau and McCann state that "only humans command"[124] as only humans can express creativity and will. However this statement takes on another light, when faced by the employment of autonomous systems, namely what happens when human limitations

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[121] Kristin E. Schaefer, A.W. Evans III and Susan G. Hill, "Command and Control in Network – Centric Operations: Trust and Robot Autonomy," in *20th International Command and Control Research and Technology Symposium* (Annapolis, MD: 2015), 2, https://static1.squarespace.com/static/53bad224e4b013a11d687e40/t/55ae572fe4b049639622aa52/1437488943136/027.pdf

[122] Lange et al. "Command and Control of Teams of Autonomous Units…", 4.

[123] Schaefer, Evans and Hill, "Command and Control in Network…, 15.

[124] Pigeau and McCann, "Re-Conceptualizing Command and Control…, 54.

make human command a liability. Thomas K. Adams suggests that this is a likely outcome, the movement of war away from what he terms "human space" and into a realm that surpasses human ability. He states, "More and more aspects of war fighting are not only leaving the realm of human senses, but also crossing outside the limits of human reaction times." [125]

Autonomous systems will be employed in the battle space in great numbers and interlinked to share information and achieve greater situational awareness. This ability to leverage autonomous systems to act as sensors to a battle space wide intelligence collection capability will be highly sought after as it meshes with current belief that knowledge will lead to battlefield dominance and greater angular speed, the ability to outthink and anticipate enemy actions. The ability to gather information, analyze it, act upon the information and respond faster than your enemy is the key to "military dominance at all levels of warfare: strategic, operational and tactical."[126] The critical aspects of this dominance are the ability to collect data, but more importantly the ability to analyse that data into useful information, information that supports decisions and subsequent action.

The ever-increasing amount of information available to the modern commander already poses significant challenges to command. As Bezooijen and Kramer identify, the increase of data links and information flow to superior commands has historically enabled micromanagement by higher headquarters. Additionally the flow of information can quickly overload humans in command functions or even create confusion through the

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[125] Thomas K. Adams, "Future Warfare and the Decline of Human Decisionmaking," *Parameters* 12 (2011): 2, http://ssi.armywarcollege.edu/pubs/parameters/Articles/2011winter/Adams.pdf

[126] Ibid., 3.

creation of conflicting perspectives of the battle space. [127] To succeed in this highly digitized and information dense environment, the use of artificial intelligence is being explored. AI command tools will enable command nodes to process vast amounts of information at speeds unrivalled by human brains. As Bostrom and Yudkowsky point out, an AI would operate at speeds a million times faster than the human brain.[128] These tools will also create recommendations to commanders on appropriate courses of action, reducing the work of planning teams from hours into a matter of seconds. Ultimately, the real challenge to human commanders who rely on these systems will be in understanding the process the tool is using, what information filters have been established to prioritise data, reconcile data conflicts, and crate consensus in information. In order to rely on the recommendations, a commander must understand how it was reached, what was emphasised, what was omitted entirely and why.[129]

The threat to human command comes from the benefits of speed and agility that autonomous systems provide. Not only can they process information faster than human commanders, they can act upon it faster as well; this will become increasingly important as technology continues to advance to include directed energy weapons. Combat in the age of energy weapons will transpire at the speed of light, there will be no room for human reflexes or motor skills; weapons systems will have to engage, manoeuvre and defend at speeds that transcend human ability. Despite many countries' stated desire to always maintain a human in the loop, the human will become increasingly a weakness both in speed of action and physical limitations of the human body. This will lead to

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[127] Bezooijen and Kramer, "Mission Command in the Information Age…", 452.
[128] Bostrom and Yudkowsky, "The Ethics of Artificial Intelligence", 329.
[129] Adams, "Future Warfare and the Decline…", 6.

greater autonomy of weapon systems and the removal of the human in the loop. In the realm of cyber war, humans will quickly be outclassed by artificial intelligences that operate at the speed of electronic circuits.[130] Humans will quickly become a limiting factor, and the combatant who removes humans from the loop will possess a critical advantage. The next step, command by artificial reality, is "merely a software tweak" away.[131]

Pigeau and McCann demonstrate via their command model and the desired balanced command envelope concept that automated command would be very dangerous. Firstly they argue that as autonomous systems and AI are unable to take responsibility for their actions, as they are not moral agents, then these systems will be equipped with full formal authority but no balancing sense of responsibility.[132] In a human command construct this would set the conditions for abuse of authority, however in an autonomous system, this would be dangerous as the AI commander has no internal or external factor to moderate the use of force. Secondly they argue that a human commander will still be held accountable and will have to accept responsibility for the actions of autonomous systems and AI under their command, including automated command system. The challenge is that they lack the full range of authority to do so due to the loss of personal authority, this is equated to an ineffectual command envelope.[133]

Summary

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[130] Ibid., 9.
[131] Ibid., 6.
[132] Pigeau and McCann, "Reconceptualizing Command and Control…", 60.
[133] Ibid.

The introduction of LAWS and AI into the command domain will create significant challenges to the competencies required by commanders, the nature of the authority they will possess and the responsibility they will bear. The employment of self-learning machines in complex operational environments will result in unpredictable behaviour that those in command will have difficulty monitoring. This creates challenges for both competency and responsibility. It introduces a requirement for those in command of autonomous forces to have an understanding of machine learning and AI programming so that they can understand the actions of their units, a requirement for command responsibility. These new Scientist-commanders will have to work within a sociotechnical command structure that enables decentralised command structures while retaining a technical oversight capability, much akin to that used in UAV command systems today.[134]

LAWS also create a challenge to the current approach to authority in command, namely it removes the requirement for personal authority from subordinates, as this is now secured through programming. Although this would appear to simplify the authority aspect of command, it in fact creates an unbalanced approach to command as formal authority is no longer tempered by the requirement for personal authority. This removes limitations on behaviour that were previously regulated by the need to gain support from subordinates through expression of values, ethics, and bravery. The removal of the requirement for personal authority also challenges one of the pillars of human command, the requirement to express will to motivate others, LAWS do not require motivation, nor leadership.

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[134] Szegedi, "UAVs and the Military…", 184.

Responsibility challenges are centred on the requirement to adhere to the legal concept of command responsibility. The unpredictability and complexity of LAWS and AI make it very difficult for a commander to have knowledge of subordinate behaviour either prior to or during the commission of a war crime. The recurring theme is again a requirement for predictability and an increase competency requirement for commanders. Another suggestion is that there should exist a formal structure within which LAWS are employed, thus enabling commanders to both know what is acceptable and be held accountable for the actions of their subordinates.

Finally, the very nature of human command, human in the loop, is threatened by LAWS and AI. It is suggested that there will be great advantage to removing humans from the loop as the liability posed by human limitations will hinder the potential success of LAWS and AI combatants. Although many countries, including Canada have stated there will always be a human in the loop, it will only take the actions of one belligerent to reject that notion, before all other forces will have to follow suit or become obsolete.

SECTION 3 – STRATEGIC CHALLENGES

In his review of the implications of LAWS, Peter Asaro argues that their development will result in greater global insecurity and instability due to their potential to create strategic threats, commence a global arms race, be easily proliferated to non-state groups and to escalate conflicts outside of human control.[135] These issues will be examined in this section to understand how the development and employment of LAWS will create strategic challenges to any country that employs them. This section will first discuss the impact of LAWS on the Just War doctrine and the strategic threat LAWS will create to global security. Next the paper will demonstrate that LAWS threaten the democratic principles of warfare by reducing the requirement for support and sanction from their citizens to enter into conflict, and how this can lead to an increased threat of asymmetric attack. Finally the paper will review the calls to ban autonomous weapons and detail some of the key challenges that control regimes will face.

Just War Theory

The previous sections have dealt exclusively with *jus in bello* aspects of the employment of LAWS, how they challenge the ability to wage ware in a just manner. However there is another aspect of war that LAWS will create challenges, namely *jus ad bellum*, the just reason to go to war. Modern just war theory does not ban all war as immoral, instead it seeks to establish a framework for debate in order to assess decisions to enter war on a moral plane. Just war theory requires that the state committing

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[135] 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): 692, doi:10/1017/S1816383112000768.

aggression have a just cause and seek a just peace in order to justify the use of force. Despite the inherent link between just cause and proportionality, the two aspects of *jus ad bellum* and *jus in bello* can be viewed as separate criteria. The example is highlighted that soldiers can wage an unjust war justly by adhering to *jus in bello,* but waging war justly may never make the war itself just.[136]

LAWS are inherently destabilizing at the strategic level. Sauer argues that the removal of the human factor can create weapons that are too small, too fast, and too stealthy to effectively defend against. Autonomous weapons systems increase the threat of surprise attacks that can neutralize strategic deterrents such as nuclear weapons or strategic command and control systems. In addition it is suggested that the speeds LAWS will be able to operate at could cause an interaction between two autonomous forces to escalate a conflict from crisis to full blown war faster than humans can intervene and attempt to de-esclate the conflict. This may create potential existential threats that j*us ad bellum* may not recognize.[137]

As Heather Roff outlines, targeting is a process that requires intervention from the tactical to the military strategic and political strategic realms. The creation of targeting lists is a strategic process involving a myriad of operational, legal and political considerations which match means to ends.[138] Although target lists could be created and loaded into the LAWS, there must be a process by which those lists can be modified to reflect changes in the operational and strategic environments. This can be done through

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[136] Peter Asaro, "How Just Could a Robot War Be?" in *Current Issues in Computing And Philosophy*, ed. Adam Briggle, Katinka Waelbers and Philip A. E. Brey (Amsterdam, The Netherlands: IOS Press, 2008), 53.

[137] Sauer, "Stopping 'Killer Robots'…", 10.

[138] Heather M. Roff, "The Strategic Robot Problem: Lethal Autonomous Weapons in War," *Journal of Military Ethics* 13, no. 3 (2014): 217, doi:10.1080/15027570.2014.975010.

data links while an operation is ongoing, or the machine can be enabled to modify targeting lists based on its own assessment of the battle-space. Giving LAWS the ability to execute an onboard targeting process is making them a *defacto* commander as targeting is an act of command. As Heather Roff states, "a [lethal autonomous robot] then, becomes a strategic actor."[139] This essentially undermines the requirement for political and military elite involvement in warfare. Sauer supports this view suggesting that full autonomous operation in combat will also compromise political control over the targeting process; "it would essentially require human abdication of political decision-making".[140] This fusion of strategic delegation and lethal targeting creates the conditions for accidental or unwarranted conflict.

The potential for an accidental war triggered by LAWS is predicated upon the idea that an unintentional act by autonomous systems can be viewed as an act of war by another nation. As Asaro points out, "all large complex technological systems are prone to unpredictable errors in unforeseeable circumstances, the systems of control for autonomous robotic armies will be too." [141] The themes of unpredictability, complexity, and normal accidents theory have been discussed throughout this paper, thus Asaro's statement is accurate; it is not if a system will break down or exceed human ability to control, but when. The response by a defending state would be a just action if it meets the requirement for self-defence, or if they take a pre-emptive strike against impending aggression. Extant just war theory works well to address these issues when the

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[139] Ibid., 219.
[140] Sauer, "Stopping 'Killer Robots'…", 10.
[141] Asaro, "How Just Could a Robot War be…", 54.

unintentional act is identified as such by the defender, and the perceived aggressor backs down. [142]

It is when the autonomous systems act on their own intention that Just War theory is challenged. This situation could arise when systems possess full autonomy and can act as moral agents. These systems may develop intentions that differ from those of the state and then act upon them. It may then be impossible to attribute the actions of the system to be representative of the state, as the state may no longer be in control of the system. In these cases, determining the acceptable response via just war theory may not work. The system has in effect gone rogue and is beyond state control. Due to the moral agency of the system, the system itself can be held responsible for its actions, but the responsibility for the state that created the system is less clear. Just war theory would indicate that the system can be attacked, but the state that created it may not; this creates a conflict in the legal cause to go to war, namely how does one attack an autonomous system without attacking the country in which it resides.[143]

Reducing the Threshold to War

It is also suggested that the employment of LAWS will increase the resort to war by politicians who are no longer constrained by potential loss of their citizens' lives.[144] Regardless of the cause used to satisfy the *jus in bellum* requirement, there is also a requirement for a democratic leader to garner support for a war effort. Part of this is the estimation of national treasure, measured in blood and gold, required to execute a war. This has, in the modern past, limited military involvement to less risky forms of fighting

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[142] Ibid.
[143] Ibid., 55.
[144] Stephen Goose, "The Case for Banning Killer Robots: Point," *Communications of the ACM* 58, no. 12 (2015): 43, doi:10.1145/2835963.

such as air campaigns and surgical strikes carried out by special forces. The ongoing drone campaigns in Pakistan, Afghanistan and Yemen are a current example.[145]

The move to network centric operations leveraging technology such as UAV and drone strikes combined with Special Forces operations all shielded from public view, marks a shift toward unaccountable conflict, and the potential undermining of the democratic principles. The operations of JSOC in Afghanistan, Pakistan, and Yemen, networked across US agencies and allies enabled the engagement and killing of over 2,000 alleged militants in Pakistan alone, without the need to seek public consent.[146] As John Williams argues, technology that produces a better solution in conflict should be used; therefore there is a duty to employ technologically superior solutions. Deploying UAVs to reduce the risk to human forces is, in his eyes, a moral duty, deploying autonomous systems in their place is the logical and a natural evolution of this train of thought.[147] Brunstetter and Braun state that the increased use of drones "further isolates the American people from military action, undermining political checks on the use of force" and "the lack of public accountability raises ethical concerns similar to the privatization of military forces."[148] Thus enabling foreign policy by proxy and conducting combat outside effective political control.

The removal of the human element from combat will simultaneously remove the check on national leaders to enter into war. The concentration of power into the hands of

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[145] Ian Shaw and Majed Akhter, "The Dronification of State Violence," *Critical Asian Studies* 46, no. 2 (2014): 213, doi:10.1080/14672715.2014.898452.

[146] Steve Niva, "Disappearing Violence: JSOC and the Pentagon's new cartography of networked warfare," *Security Dialogue* 44, no. 3 (2013): 197, doi:10.1177/0967010613485869.

[147] John Williams, "Democracy and Regulating Autonomous Weapons: Biting the Bullet While Missing the Point?" *Global Policy* 6, no. 3 (2015): 184, doi:10.1111/1758-5899.12203.

[148] Daniel Brunstetter and Megan Braun, "The Implications of Drones on the Just War Tradition," *Ethics and International Affairs* 25, no. 3 (2011): 354, doi:10.1017/S0892679411000281.

politicians and military elites may undermine the democratic process, creating an opportunity for governments to use force without having to seek consent from the population, akin to the current drone use in Pakistan. Removing the requirement for mobilization also removes the necessity to seek consent from the population and removes the requirement for leaders to gain support from their military forces currently required via IHL by the mandate for soldiers to refuse to fight an unjust war via unjust means.[149] Asaro states that just wars do not need a lowering of this threshold, the threshold is met via just war theory, thus the lowering of the threshold will most greatly impact the political propaganda requirements of the aggressor, not the defender or intervener.[150]

Threats of Assymetry

It has also been argued that the use of LAWS will create greater asymmetrical threats to the operating state.[151] Those seeking to defeat western military powers have looked towards attrition warfare in attempts to strike our centres of gravity, namely national support, through the creation of casualties. Countries such as the US have looked upon UAV strikes as a method of avoiding this threat, instead of putting military members in harms way; the drone becomes the threat surrogate. LAWS will simply be another step towards that end, with autonomous systems replacing the UAV and its operator back home. However this shift to exported warfare via LAWS further limits our adversaries attempts at attacking our national support. Sukman argues that an adversary facing LAWS will seek ever more asymmetric methods to strike at our national will. This

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[149] Thomas W. Simpson and Vincent C. Müller, "Just War and Robots' Killing," *The Philisophical Quarterly* 66, no. 263 (2016), 320, doi:10.1093/pq/pqv075.

[150] Asaro, "How Just Can a Robot War be…", 58.

[151] Daniel Sukman, "Lethal Autonomous Systems and the Future of Warfare," *Canadian Military Journal* 16, no. 1 (2015): 48 http://www.journal.forces.gc.ca/vol16/no1/PDF/CMJ161Ep44.pdf.

is likely to include the use of kinetic actions in the homeland, such as bombings of military facilities, the defense contractors who manufacture the systems, or the neutralization of command systems via cyber attack. [152] By exporting the threat from our homeland to foreign conflicts via LAWS, we will import an increased risk to the homeland.

Another aspect of the asymmetric form of warfare represented by drones and future LAWS use is presented by Kerr and Szilagyi, namely that the removal of the human from the battle space will result in a skewing of the balance between humanitarian ideals and military objectives. The continued distancing of humans from the conduct of war simultaneously reduces empathy towards declared military objectives. As humanity is reduced, so is the concern about the effects a nations forces will have on the opposing side, essentially increasing the ease at which targets will be identified as a military necessity. Kerr and Szilagyi argue that the very nature of conflict is changed if ones forces are never in danger. The removal of human investment in conflict precludes leaders from being "able to see, understand, and inculcate the humanitarian norms in tension during battle."[153] The understanding and respect for humanitarian principles underlie IHL and thus it is suggested the use of LAWS will profoundly destabilize the accepted framework of war.[154]

Control Regimes

The challenges autonomous systems and AI present to the future conduct of war create such a risk and threat to global stability that there is a significant call for their

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[152] Sukman, "Lethal Autonomous Systems and the Future of Warfare," 48.
[153] Kerr and Szilagyi, "Evitable Conflicts, Inevitable Technologies?...", 34.
[154] Ibid., 35

control. This ranges from outright bans on research, development, and production to more moderate approaches of implementing control regimes such as those for chemical weapons, land mines, and cluster munitions.[155] One of the most vocal civil society movements actively campaigning for a ban on autonomous weapons is called the Campaign to Stop Killer Robots. This is a coalition of 61 different groups across 26 countries that are linked by the efforts of Human Rights Watch and include NGOs such as Amnesty International, Article 36, and Mines Action Canada on their steering committee. This group is backed by a large array of scientists, academics, and experts in the fields of robotics, artificial intelligence, arms control, human rights law, and international security.[156] This movement seeks a total ban on autonomous systems and artificial intelligence in two key areas, the automation of targeting and the use of force.[157]

The argument for banning LAWS is not recent. On July 28, 2015, an open letter was published which was signed by more than 3100 AI professionals, roboticists and others arguing for a ban on LAWS. One of the key arguments cited in the letter supporting a ban was the detrimental effect that LAWS would impose on global security. The first aspect of this global insecurity would be the impending arms race that would result from one nation acquiring this technology. As the open letter stated "if any major military power pushes ahead with AI weapon development, a global arms race is virtually inevitable."[158] A 2013 report of the Special Rapporteur on extrajudicial, summary or

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[155] Bonnie Docherty, *Losing Humanity*…, 46.

[156] Campaign to Stop Killer Robots, "About Us," accessed 7 December 2017, https://www.stopkillerrobots.org/about-us/.

[157] International Committee for Robot Arms Control, "ICRAC Statement at the 2017 CCW GGE Meeting," last accessed 7 December 2017, https://icrac.net/2017/11/icrac-statement-at-the-2017-ccw-gge-meeting/.

[158] Goose, "The Case for Banning Killer Robots…", 43.

arbitrary executions, Christof Heyns, produced on lethal autonomous robotics supported this view stating:

> As with any technology that revolutionizes the use of lethal force, little may be known about the potential risks of the technology before it is developed, which makes formulating an appropriate response difficult; but afterwards the availability of its systems and the power of vested interests may preclude efforts at appropriate control. This is further complicated by the arms race that could ensure when only certain actors have weapons technology.[159]

Beyond the potential arms race that is predicted above, there is also a real threat to global security and stability due to the potential for proliferation. Control of autonomous systems is considered to be important due to the ease of proliferation of the underlying technology. Fundamentally, autonomy is software, and like any piece of software, can be easily shared amongst these actors. The hardware aspect of LAWS is complicated as the technology is primarily dual use. Military applications are only one of many possible uses, which means the hardware component is widely accessible. This creates the very real threat of the diffusion of autonomous weapons systems to extremist groups seeking to wage asymmetric warfare,[160] and a likelihood that this technology will proliferate to non-state actors and repressive regimes becoming "perfect tools of repression and terror for autocrats."[161]

LAWS represent a fundamental shift in the ways wars are fought, they could be considered a revolution in military affairs[162], and as such it is argued that they require new laws to clarify IHL and control their development and use. In addition to establishing control regimes State treaties also serve the purpose of stigmatizing weapons

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[159] Heyns, "Report of the Special Rapporteur…", 7.
[160] Sauer, "Stopping 'Killer Robots'…", 12.
[161] Goose, "The Case for Banning Killer Robots…", 43.
[162] Heyns, "Report of the Special Rapporteur…", 7.

which has a powerful effect on controlling use by treaty participants and non-participants. Essentially many countries wish to avoid being labelled a pariah state by their use of controlled or banned weapons.[163]

The Convention on Certain Conventional Weapons (CCW) would be the logical forum to address autonomous weapon systems. There are currently 123 countries party to this convention and it addresses weapons that are considered excessively injurious or weapons whose effects are considered indiscriminate. The CCW is an overarching framework that relies on specific protocols for different weapon classes for example, Protocol II addresses landmines, and Protocol IV banned blinding laser weapons.[164] The CCW is notoriously slow and unsuccessful in addressing emerging weapons however. Despite attempts to negotiate solutions on anti-personnel landmines and cluster munitions, the CCW failed to achieve effective outcomes for both weapons. It took measure outside of the CCW framework to achieve any form of regulation of both, the Ottawa treaty, and the Convention on Cluster munitions. The CCW has however, been aggressively debating autonomous weapons with a series of meetings since 2014, the most recent occurring 13-17 November 2017 where a group of Governmental Experts on LAWS met for the first time.[165]

There are four likely outcomes of any attempt to regulate autonomous weapons. A comprehensive arms control agreement created through consensus at the CCW also known as a ban would be the first option. Next would be restrictions on the development

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[163] Goose, "The Case for Banning Killer Robots…", 45.
[164] Sauer, "Stopping 'Killer Robots'…",10,
[165] United Nations Office at Geneva, "2017 Group of Governmental Experts on Lethal Autonomous Weapon Systems (LAWS)," last accessed 7 December 2017, https://www.unog.ch/80256EE600585943/(httpPages)/F027DAA4966EB9C7C12580CD0039D7B5?OpenDocument.

or use of LAWS that fall short of a ban but do create limitations on capabilities or methods of employment. Thirdly, a declaration of best practices by the member nations, this would be non-binding and likely emphasize the requirements to adhere to IHL. Lastly, no outcome at all leading to the prophesied arms race and rise in insecurity that would result.[166]

The notion of a pre-emptive ban on weapons technology is not new, the most recent example being the CCW Protocol IV on laser blinding weapons. Participating states debated the issue and determined that these weapons would pose unacceptable danger to potential victims such as combatants and non-combatants. Also importantly was the recognition that these weapons were counter to the dictates of public conscience, a charge levied against LAWS by many organisations.[167] There are those that challenge the possibility of any arms control efforts toward autonomous robots, arguing that as they represent such a significant advancement in military technology, no country can afford to be left behind without leaving themselves vulnerable. However this argument could be compared to the same discussions surrounding landmines that achieved a form of regulation via the 1997 Ottawa Treaty.[168]

Arms control regimes will face unique difficulties when faced by LAWS. Firstly there is a strong moral argument for their use. Despite the ethical challenges discussed previously, there is a moral argument that supports the use of LAWS as they will save lives by removing humanity from the battlefield. Many nations will state they have a moral obligation to reduce the threat of harm to their military forces, removing the human

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[166] Sauer, "Stopping 'Killer Robots'…",12.
[167] Goose, "The Case for Banning Killer Robots…", 45.
[168] Simpson and Müller, "Just War and Robots'…", 303.

from the battlefield is a strong expression of this moral belief, however, as noted before the moral good achieved by removing humans from the battlefield also contributes to the lowering of the threshold to enter into conflict, so this principle carries with it a certain amount of risk.[169]

Defining what is being regulated is another challenge to arms control regimes posed by autonomous systems. As has already been discussed, defining autonomy is not easy; despite the many attempts to establish taxonomies, autonomy remains a complex concept. This is different from other weapons systems that are banned as the system is defined by factors such as range, payload, and capability. Lethal autonomy is not a weapons system, it is a feature set programmed into a weapon system. As Wallach states, "The difference between a lethal and non-lethal robotic system may be little more than a few lines of code."[170]

Separating out military applications from civilian applications will also be exceptionally challenging. The vast majority of advancement in autonomous technology is being realized in the commercial sphere instead of for defence purposes. Funding for military research and development is fraught with organisational infighting and a lack of coherent vision.[171] The research and development funding available in the private sector outstrips defence funding as industry competes for what is considered a multi-billion dollar consumer market. Technology companies such as Google, Amazon, and Apple, instead of the traditional defence contractors, are driving this rapid pace of development.

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[169] Wendell Wallach, "Toward a Ban on Lethal Autonomous Weapons: Surmounting the Obstacles," *Communications of the ACM* 60, no. 5 (2017): 29, doi: 10.1145/2998579

[170] Ibid., 29.

[171] Mary L. Cummings, *Research Paper: Artificial Intelligence and the Future of Warfare*. (London: Chatham House, the Royal Institute of International Affairs, 2017): 9, https://pdfs.semanticscholar.org/1833/82618461d9150962e458cb4032956795c25f.pdf.

The consumer market aims to realise self-driving automobiles, autonomous drone technology and advanced AI solutions.[172] The autonomous vehicle market alone is expected to be worth $42 Billion by the year 2025.[173]

It is suggested by Cummings that this will lead to a situation where commercial companies will field products much more advanced than military capabilities. The challenge is created when advanced commercial products are repurposed to military aims, making control regimes almost impossible to implement and state owned military forces at a potential tactical disadvantage.[174] As discussed previously, proliferation to non-state actors will be impossible to stop, as the hardware required is dual purpose built upon technologies developed for the civilian market. The addition of lethality is accomplished through software development that can cross national boundaries at the push of a button and be virtually indistinct from non-lethal autonomous code.[175] The goal as outlined by Goose is to ban the development of lethal autonomous systems without impeding the research and development of non-lethal applications.[176] Any attempt at control regimes especially bans under the CCW will have to clearly define what is being banned, which is exceptionally difficult. Targeting the wrong aspect of lethal autonomy in a convention will bar future beneficial research and development.

Summary

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[172] Ibid., 10

[173] Jeff Green, Bloomberg, "Driverless-Car Global Market Seen Reaching $42 Billion by 2025", Bloomberg News, 8 January 2015, https://www.bloomberg.com/news/articles/2015-01-08/driverless-car-global-market-seen-reaching-42-billion-by-2025.

[174] Cummings, "Artificial Intelligence and the Future…", 11.

[175] Wallach, "Toward a Ban…", 29.

[176] Goose, "The Case for Banning Killer Robots…", 45.

This section has provided an overview of the challenges autonomous systems place on the future of warfare. It has demonstrated that the employment of LAWS can compromise the ability of Just War theory to support the actions of nations employing these systems and curtail the ability for a nation to respond to the strategic threat they will create.

The use of LAWS further complicates justifying international acts of aggression as they fundamentally undermine democratic principles of modern war. The elimination of the human combatant reduces the barrier that national leaders must overcome to enter into conflict, namely the need to accept the loss of citizens' lives in pursuit of national objectives. It is argued this will lead to increased and hidden conflicts once leaders are removed of this burden. It has been shown that this trend has already started with the US drone campaigns in Afghanistan, Pakistan and Yemen and the introduction of LAWS will further remove conflict from the public eye. Additionally the removal of the human combatant will also eliminate the need for nations to seek acceptance and support from their armed force to wage what is argued to valid war. IHL relies on combatants refusing to fight in unsanctioned and unjust wars, this is eliminated when obedience is programmed and objection is impossible.

This increased resorting to armed conflict to resolve issues and the removal of the human combatant is also argued to increase the threat to the homeland. By removing the human target, opposing forces will now likely seek to strike at our center of gravity via asymmetric warfare conducted on the home front. It is suggested that kinetic and cyber attacks could increase against government, military and industrial targets.

The threat that LAWS create to the future of war on an ethical and legal basis has lead many groups to call for pre-emptive bans or restrictions on their development and use. There are precedents for this action, namely the CCW protocol on laser blinding weapons and the CCW is a natural forum to address a control regime for LAWS. However, there are unique challenges posed by LAWS to any control regime. These vary from trying to define what is to be controlled, the ease of proliferation, and the dual use nature of both the hardware and software involved. Any control of LAWS will be conducted in an exploding commercial sector that seeks to develop non-lethal autonomous solutions and capabilities, these commercial applications will be easily repurposed into military capabilities defying control regimes.

CONCLUSION

The issue of responsibility arose in all sections of this paper. Determining and assigning responsibility to autonomous systems is complicated due to their technological complexity, lack of transparency and lack of predictability. Assigning responsibility to a machine, which lacks moral or legal agency, is also problematic and would require resolution. Autonomous machines defy simple responsibility attribution or transference to a single human operator, however it was shown that the current use of unmanned aerial vehicle systems in ongoing drone campaigns have created a framework to support distributed responsibility across complex socio-technological systems. This permits the assignment of liability to multiple people, organisations and systems that culminate in lethal action in conflict. The employment of LAWS will require this concept to be addressed through a stakeholder discussion involving political and military elites, manufacturers, citizens, and international organisations, a directed solution will not suffice.

Beyond the issues of 'individual' responsibility rests a larger legal issue of command responsibility. Measures will have to be established that provide future commanders of LAWS the ability to predict their behaviour and understand their actions. This translates into increased competency requirements for these command staff in the areas of machine learning and programming and a requirement to produce a framework within which LAWS may be employed to assist those in command to create employment boundaries that meet with IHL.

The issue of competency has also shown a requirement to reconceptualise how command intent is communicated to autonomous systems. The achievement of common intent amongst humans requires a great deal of implicit intent that is unspoken and developed through interpersonal skills and the development of personal authority. Commanders of LAWS will have to develop new capabilities to establish clear and shared command intent with autonomous systems, just as the systems will require new capabilities to achieve common understanding. This may substantially change what militaries will look for in future commanders.

Autonomous systems will rely on AI to achieve the ability to translate intent into action. AI and robotic platforms will be able to think, respond, adapt, and react much faster than humans. AIs will think about a million times faster than a human can process information, relying on humans to make targeting decisions will neutralise any advantage the system can bring to a battle space, keeping 'humans on the loop' will similarly prove to be pointless as the human will not be able maintain situational awareness, understand the systems intent or to intervene in time to prevent action. This would incentivize the removal of humans from the control of autonomous systems and the empowerment of LAWS with a targeting capability. However as discussed, this creates a strategic capability as targeting starts at the strategic level and requires political inputs. Any attempts to enable LAWS to possess a robust targeting capability will lead to the abdication of political oversight of the conduct of a conflict and could lead to escalation outcomes that could threaten a just peace.

The empowerment of autonomous systems to conduct targeting also creates challenges to command concepts as targeting is a command function and one of the key

methods employed by commanders to guide and align actions in the battle space, creating autonomous commanders results in systems that possess full legal authority to act, but no countering sense of responsibility. It also removes the ability to apply empathy to the selection and prosecution of military objectives, a concept that underpins IHL. This creates a dangerous situation where all of the factors that modern command concepts rely upon to moderate the employment of military force are removed.

Finally the strategic challenges created by autonomous systems and AI are severe. The current use of UAV systems in conflicts are heralding the outsourcing of combat and the removal of the element of risk to combatants. This has already led to the conduct of campaigns out of the view of the population of the involved countries and has seemed to lead politicians to enter conflicts they otherwise would not have if conventional human combatants were to be used. It is not a large leap to see that autonomous systems will simply replace remotely piloted solutions when the technology delivers a workable solution. This lowering of the threshold to enter conflict and the ability to avoid having to gain support from a military force would seek to undermine current understanding of IHL and Just Cause theory, a future of perpetual conflict can be prophesised. Additionally although the use of UAV and LAWS would seem to reduce the threat to a nations forces, it may, in fact, create great risk for those on the home front, as opponents wage increased asymmetric warfare against citizens, industry, and infrastructure in order to undermine a nations' will to fight.

Given the significant advantage autonomous systems and AI bring to the future of war, it will be hard to avoid a massive arms race as every state and non-state actor that wishes to remain relevant will seek to acquire or develop this technology. Proliferation

will be easy as the technology is mostly dual use, only minor alterations to code are required to turn a non-lethal autonomous system into a weapon. Arms Control regimes could be used to pre-emptively ban these systems or moderate their development and use. However autonomous systems will create challenges never before experienced by arms control agencies.

Defining autonomy is not easy, nor is assessing it from a moral or legal perspective. Autonomy is not a weapon; it is a feature or capability design within a weapon system. It is fundamentally nothing more than code, but represents the ability for a system to replace humans in processes. When assessing autonomy first one must analyze the action that autonomy is replacing, the relationship between the machine and the human operator that has now changed. Once it has been determined that this action is moral or legal, then one has to determine if having a machine or robot execute that action (instead of a human) creates moral or legal issues. This is further complicated by the layered approach to autonomy that a complex system will require and the fact that autonomy changes over time to reflect changes in the mission and the environment. The fact that autonomy is simply code that enables the realisation of programmed intent also challenges control regimes that would seek to restrict or govern the use of autonomy in conflict. A decision will have to be reached if it is the technology that requires oversight and control, or the conduct of the technology. This will affect the nature of IHL control methodology that could be applied.

Finally there is an underlying philosophical debate that must occur to address the requirement to respect human dignity imbedded in IHL. Despite the arguments that fielding LAWS will create a more moral combatant, one free from emotions that drive

human error, there remains the question of allowing a machine to decide to kill human beings. The question must be addressed by all stakeholders again, is this the future we wish to create, if not what steps must be taken to retain an element of humanity in the battle space?

This paper has surveyed a number of challenges that the Government of Canada and the Canadian Armed Forces must address in order to successfully develop and employ autonomous systems and artificial intelligence in the future battle space. A number of these challenges would seem to undermine basic principles of international humanitarian law and accepted norms in relation to command and control of military forces from the political to the tactical levels. Although technology may solve some of these issues, the majority will require a collaborative approach between military and political elites, international organisations, industry, and the citizens of Canada. Complex and difficult discussions will have to take place to achieve a consensual approach to issues that may alter the way we look at conflict and the conduct of military forces.

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