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LEVERAGING AUTONOMOUS TECHNOLOGY FOR ADVANCED JOINT WARFARE

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JCSP 45

Exercise Solo Flight

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INTRODUCTION

Developments in Autonomous Weapons Systems (AWS) have recently generated debates both in the military and academic circles. Issues surrounding these debates include the ethics, legality and advantages involved in using AWS.¹ Nevertheless, AWS are now an almost ever present military component in Allied Forces operations on the contemporary battlefield. AWS becomes synonymous with notions of independent and self-directed machines presumably requiring less skilled operatives, hence potentially reducing organisational costs and arguably resulting in loss of human control over warfare. AWS can be fully autonomous, human-supervised, or semi-autonomous. Full AWS are defined as weapon systems that once programmed and initiated decide on and engage targets independently without human operator interference. Human-supervised AWS are developed to allow human operators overruling their operations, thus giving humans the potential to arbitrate and where necessary abort execution of tasks.² In this paper AWS will mean both fully AWS and human-supervised AWS.

Experimental physics experts Jürgen Altmann and Frank Sauer, argue that as advancement in Artificial Intelligence (AI), Robotics and Machine Learning continues to saturate the civilian sphere; militaries should progressively exploit such technologies to enhance their efficiency and effectiveness.³ Proponents of AWS also suggest that adopting technology offers various benefits such as reduced military expenditures and bringing an innovative era of civilization while reducing

¹ Linda Johansson, “Ethical Aspects of Military Maritime and Aerial Autonomous Systems.” *Journal of Military Ethics*, 17:2-3, 140-155 from DOI:10.1080/15027570.2018.1552512. on 08 April 2019.

² US Department of Defense, “Autonomy in Weapon Systems”. Directive no. 3000.09, (21 November 2012), 13-14 from <http://www.esd.whs.mil/Portals/54/Documents/DD/issuances/dodd/300009p.pdf> on 12 March 2019.

³ Jürgen Altmann & Frank Sauer, “Autonomous Weapon Systems and Strategic Stability.” *Survival*, 59:5, (2017), 117-142, from DOI: 10.1080/00396338.2017.1375263 on 12 March 2019.

brutality in warfare.⁴ Political Scientist Michael Horowitz, contends that developments in AWS continuously cause advancement in new military capabilities with effects that can be felt across warfare domains and in all operational functions. Operational functions such as Command, Sense, Shield, Act and Sustain will all therefore be affected by AWS. The change brought along by AWS therefore calls for modification in implementing operational functions by incorporating AWS capabilities. Horowitz further argues that militaries which do not adapt and employ AWS risk losing relevance to existing warfare techniques.⁵ Technology advancement analyst Larry Lewis argues that the coming decades shall witness significant advances in AWS which no one can ignore.⁶ Influence of AWS in the field of national security is continuously increasing and will continue to do so in the future.⁷ It consequently becomes imperative for the Canadian Armed Forces (CAF) to exploit and embrace AWS. Despite the advantages offered, such weapon systems also pose questions about their employment.

AWS advancements have raised significant and complex ethical, legal and security questions. Debates amongst governments, militaries, scholars and human rights activists have done little to resolve such questions.⁸ This impasse later on in September 2009 led to creation of the International Committee of Robot Arms Control (ICRAC). ICRAC demands banning of AWS because of ethical and legal concerns with regard to International Humanitarian and Human Rights

⁴ Jürgen Altmann & Frank Sauer, “Autonomous Weapon Systems and Strategic Stability.” *Survival*, 59:5, (2017), 117-142, from DOI: 10.1080/00396338.2017.1375263 on 12 March 2019.

⁵ Ibid.

⁶ Larry Lewis, *Insights for the Third Offset: Addressing Challenges of Autonomy and Artificial Intelligence in Military Operations* (Arlington, USDOD, September 2017), iv.

⁷ Michael C. Horowitz, “The promise and peril of military applications of artificial intelligence” *Bulletin of The Atomic Scientists* (April 23, 2018) accessed online https://thebulletin.org/landing_article/the-promise-and-peril-of-military-applications-of-artificial-intelligence/ on 08 October 2018.

⁸ L. Righetti, Q.C. Pham, R. Madhavan and R. Chatila, “Lethal Autonomous Weapon Systems: Ethical, Legal, and Societal Issues.” *IEEE Robotics & Automation Magazine*, Volume: 22, Issue: 1, (March 2018), 123-126 from DOI: 10.1109/MRA.2017.2787267 on 12 March 2019.

Laws (IHL and IHRL).⁹ This dilemma entails that for the CAF to embrace and exploit the rewards offered by AWS there has to be a deliberate effort to clear out pessimism from segments of the society with negativity towards employment of AWS. Failing to do so will erode political and public support towards any effort to develop or procure AWS.

Should the CAF still embrace AWS in all battlefield domains despite the prevailing ethical and legal dilemma? What benefits can CAF exploit by doing so? CAF must embrace AWS so as to remain a relevant and reliable force for future warfare, failure to do so will erode CAF's effectiveness in coming decades making it obsolete. Incorporating AWS on the battlefield will multiply efficiency in all the operational functions as the future battlefield becomes automated. This paper evaluates the advantages armed forces including CAF can realise by incorporating AWS in their doctrines and training techniques and procedures (TTPs). The paper will begin by explaining the meaning of AWS, and then describe the concept of Adaptive Dispersed Operations (ADO) as stipulated in the CAF Doctrine as future method of warfare. Thereafter, the paper will examine how AWS will benefit the operational functions in all warfare domains; finally the discussion will endeavour to clear the legal and ethical stalemate on use of AWS.

Explaining AWS

Wars fought in the late 20th and early 21st century demonstrated that industrial revolution and technology offer tactical rewards on the battlefield. The technological reliance of the battleground will not backtrack; forces must rather adopt and use technology to their advantage so as to maintain relevance to the present and prospective joint warfare. In this Information Age, (IA)

⁹ P. Asaro, "On banning autonomous weapon systems: human rights, automation, and the dehumanization of lethal decision-making." *International Review of the Red Cross, Volume 94, Number 886, (Summer 2012)*, 687-709 from <https://doi.org/10.1017/S1816383112000768> on 12 March 2019.

Artificial Intelligence (AI), Machine Learning and Robotics which when fused compose AWS are likely to infest battlefield applications. AWS will become an extraordinary force multiplier on the battlefield, thereby complicating warfare to forces that fail to timely acquire them because for instance human soldiers to be fighting against AWS might be frustrating for humans.

International Security specialist Nathan Leys describe AWS as use of AI, robots, machinery, computer systems or any combination thereof to execute actions which originally stood only amenable towards human thinking. He further contends that AWS entails corporation between humans and machines on the battlefield leading to what he calls “Human-Machine Collaboration” (HMC).¹⁰ The United States Department of Defence (US DoD) conceptualises AWS as a “Human-Robot Interaction” (HRI) between designers, commanders, soldiers, robots and computers.¹¹ The two however agree that AI is the main element in both concepts. One can therefore argue that while grand strategic and military strategic leaders make decisions from the information they receive; decisions by operational and tactical commanders will be affected by HRI or HMC as AWS will always be involved.

Leys also argues that AWS development is dependent on desired level of control over them by human operators. These degrees of control can be compared to Observe-Orientated-Decide-Act (OODA) developed by James Boyd.¹² Using the OODA Loop to describe AWS development has two advantages. Firstly, it simplifies the explanation and secondly it fits in very well to categories of control as laid out by Human Rights Watch (HRW).¹³ It is therefore easily understood by the military and civilian authorities as well. HRW classify AWS into three

¹⁰ Nathan Leys, "Autonomous Weapon Systems and International Crises," *Strategic Studies Quarterly* 12, no. 1 (2018), 48-73 from <http://www.jstor.org/stable/26333877> on 12 March 2019.

¹¹ Ibid.

¹² Ibid.

¹³ Ibid.

categories: first is the one which humans select and engage target targets; in OODA Loop referred to as “Human-In- The Loop”. The second class is where AWS select and engage objectives with human supervision. Humans have supreme control over operations of the AWS; in OODA Loop referred as “Human-on-the-Loop”. Lastly, full AWS involves the systems selecting and engaging; in OODA Loop referred as “Human-out-of -the-Loop”.¹⁴ Regardless of the control levels; AWS that operate in the maritime domain are mostly called Maritime Autonomous Systems (MAS). Those operating on the ground are called Unmanned Ground Vehicles (UGVs) while those in the aerospace are Unmanned Aerial Systems or vehicles (UAS or UAVs). AWS can either be lethal or non-lethal, kinetic or non-kinetic. Some AWS can only be designed to process, control or disseminate information. AWS therefore goes beyond MAS, UGVs and UAVs. The AWS in all these domains remain useful if CAF is to realise ADO Concept.

Adaptive Dispersed Operations

CAF doctrine envisions ADO as a solution to the future Operational Environment (OE) which is forecasted as multi domain and fluid necessitating adaptive, agile, and dispersed military operations. In ADO CAF must be able to widely disperse in time and space. ADO demands speedy decision making processes and Network Centric Warfare (NCW) which cannot be realised without employing AWS.¹⁵ ADO concepts demands commanders to be knowledgeable on the nature of the future OE and make best use of available technological assets. Information Technology (IT) which is embedded in AWS enables commanders to squeeze time and space thus complicating the OE.

With regard to operational functions; Sense, Act and Shield, ADO concept emphasises

¹⁴ Nathan Leys, "Autonomous Weapon Systems and International Crises," *Strategic Studies Quarterly* 12, no. 1 (2018), 48-73 from <http://www.jstor.org/stable/26333877> on 12 March 2019.

¹⁵ Andrew B. Godefroy (ed), *Land Operations 2021: Adaptive Dispersed Operations: A Force Employment Concept for Canada's Army of Tomorrow* (Kingston, Ont: Directorate of Land Concepts and Doctrine, DND Canada. 2007), 16-18.

incorporating AWS in their execution to enhance swiftness of action. In ADO, Sustainment will also maximize technology to allow continuous logistical support small dispersed teams which will overwhelm field echelon systems.¹⁶ ADO cannot therefore be realised without embracing AWS into the operational functions.

AWS IN OPERATIONAL FUNCTIONS

Incorporating AWS into CAF military capabilities will benefit strategic, operational and tactical levels of war. Military systems technical analyst Larry Lewis argues that while nuclear deterrence and reconnaissance acted as first and second offset strategies respectively, operationalising AWS into operational functions acts as a third offset strategy for political leaders and strategic military commanders.¹⁷ An offset strategy is an approach that alters unattractive rivalry to a more advantageous position against adversaries. In this way, AWS becomes a competitive strategy to maintain advantage over adversaries over long periods while preserving peace and acting as a deterrence where possible.¹⁸ At operational and tactical levels, exploiting AWS has brought development of equipment pieces that implement difficult assignments better than human abilities.¹⁹ AWS can thus be employed as valuable operational enablers thereby increasing the speed of activities on the OE. Lewis also argues that AWS improve accuracy from planning up to execution and also assist in Battle Damage Assessment (BDA).²⁰ Benefits can be realised when AWS are integrated into all operational functions. The first operational function is command.

¹⁶ Andrew B. Godefroy (ed), *Land Operations 2021: Adaptive Dispersed Operations: A Force Employment Concept for Canada's Army of Tomorrow* (Kingston, Ont: Directorate of Land Concepts and Doctrine, DND Canada. 2007), 27.

¹⁷ Larry Lewis, *Insights for the Third Offset: Addressing Challenges of Autonomy and Artificial Intelligence in Military Operations* (Arlington, USDOD, September 2017), 2-6.

¹⁸ Ibid.

¹⁹ Ibid, iii.

²⁰ Ibid, 2-6.

Command

During operations, information continuously flows to Command Posts (CP) at all levels of command. Poor information management is likely to overwhelm processing capacity of CPs; this over-saturation may lead to information overload which consequently lead to either delays or wrong decision making. AWS embedded with AI algorithms assists staff to organise, store and manage information. Such systems also assist in rapid data analysis to support informed decisions. Use of AWS in data analysis provides considerable speed to reach the interpretation process. Simply put, the OODA loop gets accelerated.²¹ Other militaries like French military already incorporated AWS in processing of information in decision making processes. The Head of Intelligence for French Military disclosed that they are using AWS to quickly analyse classified information for military decision making on operations.²² The Defence Advanced Research Projects Agency (DARPA) is said to be pursuing a Concept of Operations (CONOPS) project where autonomous battle management systems will support human commanders by recommending courses of actions (COAs) and assist in directing robot and human pilots during aerospace domain operations.²³ This project, once complete will reduce load on human commanders while increasing command efficiency. It will also reduce the need for continuous communication from commanders according to set parameters.

AWS can be set to parameters that can enable them to operate under limited information. This ability reduces the need for frequent communications and consequently minimise possibilities of adversary hacking. Nathan Leys argues that AWS will enhance disaggregated command and

²¹ Michael C. Horowitz, "The promise and peril of military applications of artificial intelligence" *Bulletin of The Atomic Scientists* (April 23, 2018) accessed online https://thebulletin.org/landing_article/the-promise-and-peril-of-military-applications-of-artificial-intelligence/ on 08 October 2018.

²² Ibid.

²³ Nathan Leys, "Autonomous Weapon Systems and International Crises," *Strategic Studies Quarterly* 12, no. 1 (2018), 48-73 from <http://www.jstor.org/stable/26333877> on 12 March 2019.

control (C2) as AWS can be programmed to operate in information scarce scenarios.²⁴

Additionally, Leys contends that DARPA is also working on Collaborative Operations in Denied Environments (CODE) where multiple AWS will be able to independently fly, find, and engage targets.²⁵ CODE will be useful once the enemy destroys C2 assets or infrastructure as it will allow activities to continue flowing. Experience indicates that AWS using algorithmic targeting ability significantly condenses the targeting cycle.²⁶ Increased speed in cycle translates to flexibility and versatility to the operational staff and improved precision of the weaponry. Increased AWS independence means communication gaps would not directly disturb rhythm of activity on the OE. This will enable flexibility and effectiveness to commanders. It will also change the control methods.

US DoD C2 researchers David S Alberts and Richard Hayes argue that as technology advances, means of information dissemination will also evolve thus dictating means of control. As AWS platforms become convenient in information sharing they will consequently modify the hierarchical structure of C2.²⁷ Unlike in industrial age, information sharing in IA can be done by the touch of the screen. Such technological advancements will make prosecution of future wars to heavily depend on “Network Centric Warfare” (NCW). NCW involves flexible information dissemination and shared situational awareness (SA). AWS becomes handy in ensuring equal SA over widely dispersed forces in ADO within a limited timeline. This prospect allows commanders in empowering their subordinates to the edge hence distributing C2 authority.

²⁴ Nathan Leys, "Autonomous Weapon Systems and International Crises, " *Strategic Studies Quarterly* 12, no. 1 (2018), 48-73 from <http://www.jstor.org/stable/26333877> on 12 March 2019.

²⁵ Ibid.

²⁶ Stephan De Spiegeleire et al., *Artificial Intelligence and The Future Of Defense: Strategic Implications for Small- And Medium-Sized Force Providers*. (Hague: The Hague Centre for Strategic Studies, 2017), 79-80.

²⁷ David S Alberts and Richard Hayes, *Power to the Edge: Command and Control in the Information Age* (Washington: USDOD, 2005), 74.

The CAF Doctrine also emphasises training as command responsibility.²⁸ AWS have proven to be a good tool for training both the staff and the troops. The Royal Netherlands Army (RNLA) in 2012 used an AWS platform with AI overdependence in training their command and staff. The package handled both low and high intensity operations including Operations Other Than War (OOTW).²⁹ Command can therefore benefit from employment of AWS in training staff. Apart from command, sense as another operational function also stands to benefit from AWS.

Sense

AWS remains a vital element in the sense function by allowing an integration of applications in the intelligence cycle. Israel Defence Forces (IDF) is already employing UGVs as sensors around borders of the Gaza Strip.³⁰ The Russian Federation also used UGVs as sensors in Syria.³¹ UAVs and MAS are also useful in providing timely situational awareness to commanders. They are capable of infiltrating behind the enemy lines into denied areas to collect information. This ability protects the human collectors from exposure to risks as part of shield.

Shield

Shield is an operation function that can immensely benefit from AWS. The capability of AWS to deploy and operate independently deep behind enemy lines decreases the risk to human soldiers who may be deployed to perform these types of assignments. Special Operations Forces (SOF) are especially most times assigned to infiltrate behind the enemy for deep operations. AWS can produce similar outcomes as SOF thereby minimising risks human soldiers get exposed to.

²⁸ Department of National Defence, *Leadership in the Canadian Forces; Conceptual Foundations*. (Ottawa: Canadian Defence Academy – Canadian Forces Leadership Institute, 2005).

²⁹ Stephan De Spiegeleire et al., *Artificial Intelligence and The Future Of Defense: Strategic Implications for Small- And Medium-Sized Force Providers*. (Hague: The Hague Centre for Strategic Studies, 2017), 79-80.

³⁰ Ibid, 82.

³¹ Ibid, 82.

AWS also deploy into OEs with high Nuclear Biological Chemical (NBC) and mine warfare threats, thus shielding human soldiers from such threats. Russian Uran-6 Robots were successfully deployed in Syria to demine and disarm booby traps.³² Additionally, once the AWS falls into the hands of the adversary, they can be programmed to automatically destroy all necessary parts by themselves, thus denying the enemy access to intelligence and enhancing Operational Security (OpSec).³³ AWS are hence capable of providing force protection in shield function when deployed both offensively and defensively.

AWS arguably are very useful as defensive weapons. In defensive roles, they are either static or fixed on other systems and programmed to engage intimate targets. They can repetitively execute these actions in situations where parameters and time frames are tightly set.³⁴ Technological evolution which has resulted into accelerated speed of air attacks which is now beyond human soldier reaction. This development has necessitated operations of Air Defence (AD) systems like the Patriot and the Terminal High Altitude Air Defence (THAAD) to be automated to reduce delays in reactions. Furthermore, AWS in AD can independently interconnect and exchange targets for self-directed strikes, thus providing uninterrupted and synchronised AD to land, sea and air forces.³⁵ Shielding from air attacks will in the near future require AWS to ensure uninterrupted force protection and freedom of action. AWS have also proven to be extremely useful in maritime the domain with Phalanx Close-In Weapon Systems (CIWS) considered as the last line of defence anti-access/area-denial (A2D2) weapons. Phalanx

³² Stephan De Spiegeleire et al., *Artificial Intelligence and The Future Of Defense: Strategic Implications for Small- And Medium-Sized Force Providers*. (Hague: The Hague Centre for Strategic Studies, 2017), 79-80.

³³ J Khurshid. *Military Robots, A Glimpse from today and tomorrow*.(Kunming: ICARCV, 2004) IEEEExplore Digital Library online. <https://ieeexplore.ieee.org/abstract/document/1468925> accessed on 09 October 2018.

³⁴ Jen Judson, "So Patriot and THAAD will talk. What does that really mean?" *Defence News*, <https://www.defensenews.com/digital-show-dailies/ausa/2018/10/10/so-patriot-and-thaad-will-talk-what-does-that-really-mean/> accessed on 10 October 2018.

³⁵ Ibid.

(CIWS) autonomously acquires and engages incoming missiles. This quick reaction ensures no wastage of time due to the absence of humans in the OODA Loop.³⁶ As these weapons engage targets autonomously to shield, Act as an operational function is simultaneously also benefitting.

Act

As technology advances, the speed of warfare will also increase in direct proportion to such advancements. Human capabilities would not be able to prosecute warfare as the required reaction time will shrink below human abilities. AWS would then be the only solution. AWS will speed up the OODA loop subsequently multiply agility and ability to rapidly attack adversaries hence attaining surprise. Speed delivers obvious gains in contemporary conflicts. Using AWS permits for well-timed fire support to land forces as the obligation of protecting human operators is absent. Presence of human operators translates to controlled speed, reach and manoeuvre for their safety. Additionally, human operators can be overwhelmed by the high rate of activity, AWS cannot get overwhelmed. Striking AWS therefore increase flexibility in striking multiple objectives.

AWS can be programmed to find, track, and engage targets free of human collaboration. Such AWS can be tasked independently armed with lethal weapons to perform actions as desired on selected targets. In the air domain, MQ-9 Reaper is a hunter killer AWS. With the incorporated precision technology MQ-9 Reaper has proven to be effective in striking targets with laser guided munitions.³⁷ On land warfare, the Russian UGV Drone Tank Uran-9 which is claimed to have performed to excellence in Syria by providing intimate fire support to ground troops.³⁸ IDF also

³⁶ Nathan Leys, "Autonomous Weapon Systems and International Crises," *Strategic Studies Quarterly* 12, no. 1 (2018), 48-73 from <http://www.jstor.org/stable/26333877> on 12 March 2019.

³⁷ Lance Menthe, Myron Hura and Carl Rhodes, "The Effectiveness of Remotely Piloted Aircraft in a Permissive Hunter-Killer Scenario". *RAND Project of the United States Air Force* (Washington DC: RAND, 2014), 16-39.

³⁸ Ibid.

claim their Harpy anti-radiation UAV is capable of sensing and striking autonomously. IDF is in the near future planning to produce units combining humans and robots to multiply force efficiency. They are also said to be in the advanced phases of arming UGVs so that they can combine sensing and striking.³⁹ Such AWS will be capable of operating in close proximity with ground forces thereby multiplying the lethality of forces while improving their survivability. AWS permits hands off continuousness in targeting and augments firepower to human soldiers for long durations.

In operations of extended duration, rotation of troops is often necessary for rest and recovery. This activity becomes time consuming, requires operational pauses or reduced intensity of activities. On the contrary, AWS operate continuously until maintenance is required. AWS when combined with smart munitions technology reduces collateral damage. They are capable of hunting and tracking targets to the best killing area even in a contested environment thus reducing collateral damage.⁴⁰ Fear factor of pilots in hostile areas has been argued to be one of the causes of higher collateral damage and AWS becomes the answer.⁴¹ Some AWS can be designed to interact with human biology to enhance their battlefield abilities. The Tactical Assault Light Operator Suits (TALOS) under development by the United States Special Operations Forces (USSOF) will amplify mobility and load capacity of human light infantry forces.⁴² Such equipment has the potential to increase effectiveness while reducing their rate of culmination on the battlefield. Such

³⁹ Stephan De Spiegeleire et al., *Artificial Intelligence and The Future Of Defense: Strategic Implications for Small- And Medium-Sized Force Providers*. (Hague: The Hague Centre for Strategic Studies, 2017), 79-80.

⁴⁰ Lance Menthe, Myron Hura and Carl Rhodes, "The Effectiveness of Remotely Piloted Aircraft in a Permissive Hunter-Killer Scenario". *RAND Project of the United States Air Force* (Washington DC: RAND, 2014), 16-39.

⁴¹ Nathan Leys, "Autonomous Weapon Systems and International Crises, " *Strategic Studies Quarterly* 12, no. 1 (2018), 48-73 from <http://www.jstor.org/stable/26333877> on 12 March 2019.

⁴² Vivienne Machi, "Iron Man Suit On Track, But Hurdles Remain". *National Defense Magazine*. (22 May 2017). <http://www.nationaldefensemagazine.org/articles/2017/5/22/iron-man-suit-on-track-but-hurdles-remain> accessed on 14 October 2018.

systems will enhance the Act ability of the ground forces. As collateral damage is reduced, mobility and load capacity increased, precision increased; sustainment as an operational function is by extension also benefitting from AWS.

Sustain

AWS plays a critical role with regard to sustainment. In the first place during prolonged operations, necessity to rotate troops and conducting relief operations radically decreases as AWS operate constantly thus reducing transportation costs. Likewise, as AWS infiltrate the battle space, overreliance on human labour shrinks as technologies replace them, thus outbalancing need for high human recruitment and retention. The need to compensate war casualties reduces as damaged AWS shall not claim for compensation. Conversely, AWS demands better soldier technical training while the logistical supplies landscape requires extra technical maintenance resources.

Maintaining operationally required manpower levels need continuous replacements of human resources which necessitate recruitment and training; this is a resource consuming process. Some posts require humans to gain some experience for them to become effective. Additionally, it is difficult to train individuals to exactly identical proficiency levels as people are born with varying capabilities, intellect and physical abilities. AWS have an advantage as they can easily be duplicated to accurately similar level of intelligence making replenishments cheap and easy. The duplicated machines are immediately ready to carry over tasks as expected without wasting time to gain experience as required by humans, thus making sustainment easy.

As teams are scattered on the ADO battlefield, ground transport and echelon systems will not satisfy logistic requirements. AWS can carry out precision air drops of supplies even in

unreachable and hostile areas.⁴³ War studies specialist Linda Johansson argues that AWS are capable of accurately delivering payloads including logistics at designated targets.⁴⁴ Apart from that, during force mobilisation or generation phase of operations, less logistics will be required in comparison to generating human soldiers. Unlike humans, AWS can be stored for long durations with fewer upkeep requirements. AWS will neither require boots, uniforms and allowances, thus making prosecution of war cheaper and easier to sustain. Lastly, reduced demand for humans on battlefields will release the human capital to operate in the field of industrial and technological productivity thereby increasing economic productivity of the nations. Adopting AWS therefore has other overarching benefits falling outside the operational functions.

Overarching AWS Pros and Cons

Overarching advantage of AWS can be summarised into Diplomatic, Information, Military and Economic. Militarily, AWS increases the speed of activity on the OE in all domains. It further allows quick passage of information across the domains and operational function. They can be employed to achieve both kinetic and non-kinetic effects. Politically, loss of AWS will have very less outcry at home while loss of human soldiers usually has domestic political repercussions as was the case in the US during the Vietnam War. Economically, mobilisation and employment of AWS will also be beneficial as theatre deployment is easy requiring less bulky supplies.

Conversely, information becomes vulnerable especially in NCW where an attack on the data drive could be catastrophic. Comprehensive cyber security therefore becomes a key concern. Duplication of systems could however help mitigate effects of network attacks but is costly.

⁴³ Andrew B. Godefroy (ed), *Land Operations 2021: Adaptive Dispersed Operations: A Force Employment Concept for Canada's Army of Tomorrow* (Kingston, Ont: Directorate of Land Concepts and Doctrine, DND Canada. 2007), 31.

⁴⁴ Linda Johansson, "Ethical Aspects of Military Maritime and Aerial Autonomous Systems." *Journal of Military Ethics*, 17:2-3, 140-155 from DOI:10.1080/15027570.2018.1552512 on 08 April 2019.

Additionally, AWS requires complex and fragile software and hardware. This fragility renders them vulnerable to destruction, they must therefore be designed to be durable and survive harsh conditions. Another disadvantage is that AWS are designed for specified tasks. This specification in designs decreases the flexibility in assigning tasks. For instance, an AWS designed for mine clearance cannot collect information while human combat engineers doing the identical assignment can simultaneously act as human sensors. Besides, in counterinsurgency operations the centre of gravity (COG) is the local populace and it is challenging for AWS to interact with the people to win their hearts and minds. Lastly, legal and ethical considerations in employment of AWS remain complex and open to debates; this complexity presents a disadvantage for the forces using them.

Clearing Legal and Ethical Dilemma

Employment of AWS has been condemned particularly on the grounds of delegating targeting to computerised processes. This view sees machines deciding what and how to attack intolerable. Peter Asaro, a media studies professor, argues that AWS erode the human responsibility and accountability to Laws of Armed Conflict (LOAC). Applying laws that were expected to be appropriate to humans on machineries remains a critical dilemma. He further argues that issues of the possibility of hacking the AWS systems raise many questions. Once hacked, the perpetrators may calculatingly use them for terrorism or due to lack of expertise may end up causing accidents that may cost human lives.⁴⁵ Deployment of lethal AWS, according to International Committee of the Red Cross (ICRC), will lead to loss of humanity in the execution of wars. The argument is that irrespective of any prospective advances in technology, machines will

⁴⁵ Peter Asaro, "Why the world needs to regulate autonomous weapons, and soon" *Bulletin of the Atomic Scientists* (April 27, 2018) online https://thebulletin.org/landing_article/why-the-world-needs-to-regulate-autonomous-weapons-and-soon/ on 17 March 2019.

not be able to respect “Humanity” as a principle of LOAC.⁴⁶ The development and employment of AWS systems is therefore being resisted. On the other hand, proponents of AWS express optimism that such systems combined with smart technology will minimise collateral damage and cost of non-combatant lives.⁴⁷ A renowned law researcher, Merel Ekelhof, argues that there is misunderstanding and sketchy knowledge by the public with regard to AWS.⁴⁸ He contends that this ignorance arises because those that are in AWS denial only consider Lethal AWS (LAWS) disregarding the non-lethal ones. Moreover, they also disregard the fact that the “autonomy” in the fully AWS is designed by people who can change the parameters at will and control them when necessary. The argument therefore is that there is nothing like “fully autonomous weapons”. One can also argue that those opposing AWS do not understand the details of the targeting process and how it can negate doubts on ethics and LOAC. Proper following and application of the targeting process would address many ethical legal reservations about the use of AWS.

The phased structure of the targeting process with authorities and approvals ensures use of AWS is compatible with legal and ethical requirements. As shown in Figure 1 below, the targeting cycle has six steps which are: End State and Commander’s Objectives, Target Development and Prioritization, Capabilities Analysis, Commander’s Decision and Force Assignment, Mission Planning and Force Execution and Assessment.⁴⁹

⁴⁶ Kenneth Anderson and Matthew C. Waxman, “Debating Autonomous Weapon Systems, their Ethics, and their Regulation under International Law”. In *The Oxford Handbook of Law, Regulation and Technology*. (Oxford: Oxford University Press, 2017). 1104-1105.

⁴⁷ Peter Asaro, “Why the world needs to regulate autonomous weapons, and soon” *Bulletin of the Atomic Scientists* (April 27, 2018) online https://thebulletin.org/landing_article/why-the-world-needs-to-regulate-autonomous-weapons-and-soon/ on 17 March 2019.

⁴⁸ Ekelhof Merel A.C., "Lifting the Fog of Targeting: “Autonomous Weapons” and Human Control through the Lens of Military Targeting," *Naval War College Review: Vol. 71: No. 3, Article 6. (2018)*, 1-34 from <https://digital-commons.usnwc.edu/nwc-review/vol71/iss3/6> on 17 March 2019.

⁴⁹ Joint Doctrine Branch, *Canadian Forces Joint Publication: CFJP 3-9 Targeting 1st Edition*. (Ottawa: Department of National Defence, 12 December 2014), 4-1 to 4-20.

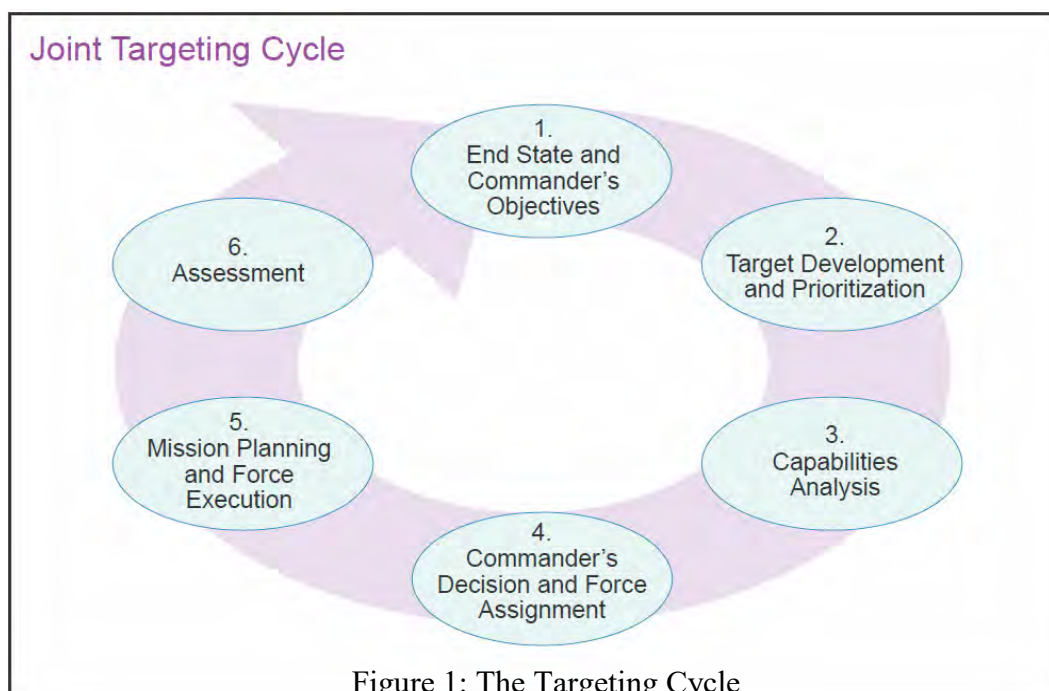


Figure 1: The Targeting Cycle

Source: Canadian Forces Joint Publication: CFJP 3-9 Targeting 1st Edition

Each of the six steps of the targeting process shown in Figure 1 above contributes to eliminating the legality and ethical fears in AWS employment. However, only the first four phases are pertinent to the debated dilemma. Step One: End State and Commander's Objectives demands commanders develop their mission, objectives, intent, priorities and desired effects while clarifying the Rules of Engagement (ROEs) and acceptable collateral damage. Commanders clearly identify what they want achieved and specify the circumstances and parameters to be followed in order to achieve the strategic direction from political leadership; these can either be military strategic or campaign objectives.⁵⁰ The campaign objectives are then in consultation with component commanders translated into operational tasks taking into account the restrictions imposed. This process cascades down in developing objectives, tasks, supporting targets and effects to all lower levels. The Force Legal Adviser (LEGAD) takes a leading role in legitimizing the target selection. This process ensures that the selected targets fall within the

⁵⁰ Ibid.

LOAC principle of “Military Necessity” and “Distinction”.⁵¹ The products of the first step are then passed to the second step which is Target Development and Prioritisation.⁵²

Step Two of the targeting cycle is heavily reliant on all source intelligence. It firstly involves Target System Analysis (TSA). TSA requires collection of detailed intelligence on each individual target from step one to determine operational and legal aspects in engaging it. Intelligence analysis on the systemic network of target components becomes pertinent at this stage.⁵³ A systemic network analysis of Air Defence (AD) system will comprise relationships of launchers, communication equipment, radars, control centre and the geographical surroundings they are based. Intelligence on systemic components helps decide where and how to best effect an action to achieve legally the desired result with minimal collateral damage. This step then involves target vetting, validation, nomination and then prioritisation. Target vetting measures the correctness of the intelligence that was used in TSA. Once vetted the targets are then validated which is ensuring that they are contributing to the commander’s objectives. Step two ensures the LOAC principle of “Military Necessity” is adhered to.⁵⁴ Before taking the targets to the next phase, the commander is consulted to approve them with the advice of the LEGAD. After approval then the targets enter the third Step which is Capability Analysis.

Capabilities analysis, also referred to as weaponeering, is selecting appropriate tools and matching them to targets lists approved in the previous phase by the commander. Depending on the targets, the weapons may be lethal or non-lethal, autonomous or human controlled, kinetic or

⁵¹ International Committee of the Red Cross, *The Law of Armed Conflict: Basic Knowledge*. (Geneva: ICRC, 2002), 1-29. Accessed online from https://www.icrc.org/en/doc/assets/files/other/law1_final.pdf on 24 March 2019.

⁵² Joint Doctrine Branch, *Canadian Forces Joint Publication: CFJP 3-9 Targeting 1st Edition*. (Ottawa: Department of National Defence, 12 December 2014), 4-1 to 4-20.

⁵³ Ibid.

⁵⁴ International Committee of the Red Cross, *The Law of Armed Conflict: Basic Knowledge*. (Geneva: ICRC, 2002), 1-29 accessed online from https://www.icrc.org/en/doc/assets/files/other/law1_final.pdf on 24 March 2019.

non-kinetic. This process is done by linking targets to the weapon capabilities to achieve the desired objectives as outlined in Steps one and two. The product of weaponeering is an endorsement on types of weapons on each target, quantity, precautions to be followed before attack and levels of accepted collateral damage. Capability Analysis therefore clears LOAC doubts with regard to principles of “Proportionality, Limitation, Human Treatments and Non-Discrimination”.⁵⁵ After weaponeering, the results are taken to step four.

Step four gives commander the authority to approve allocation of weapons to targets ensuring the LOAC principle of “Good Faith” achieved. So the final decision on how to prosecute war lies with the commander not in weapons systems. AWS hence do not in themselves have authority to use lethal power but deployed by commanders just as they do with any other weapons system. The ethical dilemma of delegating the prosecution of war to AWS is therefore annulled. Apart from the targeting process, other directives can also be initiated to ensure compliance to LOAC and ethical standards.

Apart from the Targeting Cycle, US DOD Directive 3000.09.12 stipulates restrictions in AWS development which can also help clear ethical AWS dilemmas. The Directive emphasises that AWS models must be designed to permit commanders and operators to exercise ultimate authority and judgment on the use of lethal force.⁵⁶ So gaining control of LAWS should start from the designing process and end up being complemented by the targeting cycle. The human brain is consequently the most powerful supercomputer and capable of controlling all the activities of AWS. In this way, prosecution of war cannot be delegated to AWS and LOAC is

⁵⁵ International Committee of the Red Cross, *The Law of Armed Conflict: Basic Knowledge*. (Geneva: ICRC, 2002), 1-29 accessed online from https://www.icrc.org/en/doc/assets/files/other/law1_final.pdf on 24 March 2019.

⁵⁶ US Department of Defense, “Autonomy in Weapon Systems”. Directive no. 3000.09, (21 November 2012), 13-14 from <http://www.esd.whs.mil/Portals/54/Documents/DD/issuances/dodd/300009p.pdf> on 12 March 2019.

adhered to. Restriction on design control consequently negates the legal and ethical impasse that has generated lengthy debates.

CONCLUSION

In conclusion, CAF operations are underpinned by ADO but this concept cannot be realised without embracing AWS. ADO requires increased agility, rapid dispersal of adaptive and versatile forces in time and space. ADO can only materialise if forces are networked and are quick to respond to unpredictable changes on the battlefield. ADO will surely remain just but a dream unless CAF starts to incorporate AWS in the training and operations. AWS multiplies speed, effectiveness, efficiency and accuracy in every operational function. AWS promotes ethical standards of war as they are never influenced by vengeance, fear, anger or need for self-protection thus improving the ethics. In plain language, AWS increase force effectiveness and capabilities of standoff force projection. AWS will no doubt shape the battlefield in the coming decades. CAF needs to timely embrace the technology just like what other armed forces of the world are doing. Embracing the technology will ensure CAF is not left behind as a relevant military force.

Ethical and legal fears on the use of AWS are misplaced because the targeting process and design restrictions on control clear such dilemmas. However, accidents and miscalculations in use of AWS will happen just as they do with manned systems and accidents should not derail the progress. Failure to incorporate AWS in inventories, doctrines, and TTPs represents a dangerous short-sighted approach to future warfare.

Future predictions indicate AWS advances can no longer be ignored. For CAF to continue to be a useful member of future coalitions, deliberate effort should be focussed to start developing AWS capabilities in order to be relevant within the future operating environment. Air, maritime,

ground, space and electromagnetic spectrum domain are slowly but gradually becoming automated. CAF therefore need to consider developing or procuring AWS and introduce them into the force. CFA may also consider contacting private technology companies to propose a possible venture into AWS for military purposes. In the event that CAF deems developing AWS not to be economically viable, an alternative may be considering joint ventures with other friendly militaries for cost sharing.

AWS is a necessary means to realise the country's ambitions and expectations on its military in projecting Canadian values at home and abroad. It is the only way CAF can be 'Strong' at home, be able to 'Secure North America' and be fully 'Engaged' to the global affairs (SSE) while ADO becomes a reality. The fact that Canada is world's second largest country from Russia in geographical area further justifies the need for employing AWS to dominate the large Areas of Responsibility (AOR).

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