



Padjadjaran Journal of International Law

ISSN: 2549-2152, EISSN: 2549-1296

Volume 3, Number 2, June 2019

**The Use of Autonomous Weapon Systems in Armed Conflict:
Legality and Challenges for Future Weapon Regulation**

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Abstract

Autonomous Weapon Systems (AWS) has been developed as an alternative weapon system in the battlefield. It has a fundamental difference with other weapons systems which lies in decision making carried out without human intervention. AWS is able to make decisions about life and death and it has been legally, morally and ethically challenged since it has potential to distract moral and ethical on the battlefield. However, as a smart weapon, it gives a significant advantage since it can be deployed in very dangerous areas for the purpose of self-defense in critical situations. This article argues that AWS is still a conventional weapon and cannot be absolutely prohibited even if it is deemed as a vulnerable and destructive weapon which potentially violates international humanitarian law (IHL). AWS is still fully compliant with IHL basic principles for as long as there is a sufficient legal basis that provides the limit and legality of the use of AWS. Accordingly, this article also suggests that the future AWS regulation should be followed by appropriate technical provision on the development, production, ownership, transfer and use in armed conflict.

Keywords: Armed Conflict, Autonomous Weapon Systems, International Humanitarian Law, Weapon Regulation

**Penggunaan Autonomous Weapon Systems dalam Konflik Bersenjata:
Legalitas dan Prospek Pengaturannya**

Abstrak

Sistem Senjata Otonom (AWS) telah dikembangkan sebagai sistem senjata alternatif dalam pertempuran dan memiliki perbedaan fundamental dengan sistem senjata lain yaitu, keputusan yang diambil tanpa adanya intervensi manusia. AWS mampu untuk memutuskan hidup dan matinya target kombatan sehingga penggunaannya ditentang baik secara hukum, moral, dan etika karena berpotensi merusak moral dan etika dalam peperangan. Namun demikian, sebagai senjata modern, AWS memberikan keuntungan yang nyata mengingat AWS dapat ditempatkan di daerah yang berbahaya bagi manusia untuk alasan bela diri dalam situasi yang sangat sulit. Penelitian ini menyatakan bahwa AWS tetap merupakan senjata konvensional yang penggunaannya tidak dapat dilarang secara absolut sekalipun berpotensi menjadi senjata penghancur yang dapat melanggar hukum humaniter. AWS mampu untuk mematuhi prinsip-prinsip dasar hukum humaniter sepanjang pengaturan dan pembatasan penggunaannya diatur dalam instrumen hukum humaniter yang memadai yang hingga saat ini belum tersedia. Dengan demikian, penelitian ini menyarankan bahwa aturan AWS masa depan harus juga mencakup aturan-aturan teknis

PADJADJARAN JOURNAL OF INTERNATIONAL LAW Volume 3 Number 2 Year 2019 [ISSN 2549-2152] [e-ISSN 2549-1296]

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tentang pengembangan, pembuatan, kepemilikan, pengalihan serta penggunaan dari AWS dalam sengketa bersenjata.

Kata Kunci: Aturan Senjata, Konflik Bersenjata, Hukum Humaniter Internasional, Sistem Senjata Otonom

A. INTRODUCTION

War, technology, and principles of law governing armed conflict have influenced one another. Modern technology military weapons are developed to give more protection to people and prevent undesirable consequences.¹ Technological development has changed the way of waging war which brings greater responsibility to each party to the conflict since it can give significant contribution whilst also potentially violate international humanitarian law (IHL) because of the remote human operation such as Unmanned Combat Aerial Vehicle (UCAV). However,

The process of weapons innovation plays an important role to reduce humanitarian violations at all levels of conflict. One weapon that recently developed is Autonomous Weapon Systems (AWS). The development of AWS is part of a continuous process of technological innovation and developed as the primary technology in future warfare.² The International Committee of the Red Cross (ICRC) defined AWS as, “all weapons systems with autonomy in its functions, that can select, search, detect, identify or track,

and attack (use of force, neutralize, damage or destroy) targets without human intervention.”³ This definition has a fundamental difference compared to UCAV (widely known as a drone). Both UCAV and AWS allow humans not to be physically present on the battlefield, but UCAV still has to be operated directly by a pilot as the operator. UCAV or Remotely Piloted Aircraft System (RPAS) are now increasingly automated in their flight functions, such as take-off and landing, but they still need real-time human pilots to fly and shoot.⁴ Based on these comparisons, the weapon system level of autonomy are vary and they divide into three different categories based on human involvement:⁵

1. Human-in-the-Loop Weapons (Semi-AWS)⁶: Robots that can choose targets and send attacks only by human command such as UCAV;
2. Human-on-the-Loop Weapons (Human-Supervised Weapon Systems)⁷: Robots that can choose targets and send attacks under the supervision of human operators and capable to abort the robot's actions;
3. Human-out-of-the-Loop Weapons (AWS)⁸: Robots that can choose targets

¹ Jesper Ryberg, “Technology and Personal Moral Responsibility”, on Jan Kyrre Berg Olsen (eds.), *A Companion to the Philosophy of Technology*, Blackwell Publishing Ltd, Oxford, 2009, p. 476.

² Advisory Council on International Affairs and Advisory Committee on Issues of Public International Law Report, “Autonomous Weapon Systems: The Need for Meaningful Human Control”, No. 97 AIV/No. 26 CAVV, October 2015, p. 8; see also: Ingvild Bode and Hendrik Huelss, “Autonomous Weapon Systems in Changing Norms in International Relations”, *Review of International Studies*, Vol. 44, No. 3, p. 393.

³ ICRC, “Views of the International Committee of the Red Cross (ICRC) on Autonomous Weapon System”, *Convention on Certain Conventional Weapons (CCW) Meeting of Experts on Lethal Autonomous Weapons Systems (LAWS)*, Geneva – Switzerland, 11-15 April 2016, p. 1.

⁴ Kenneth Anderson and Matthew Waxman, “Law and Ethics for Autonomous Weapon Systems: Why a Ban Won’t Work and How the Laws of War Can”, *Jean Perkins Task Force on National Security and Law*, Hoover Institution – Stanford University, 2013, p. 4-5.

⁵ Human Rights Watch [“HRW”] and International Human Rights Clinic [“IHRC”], *Losing Humanity: The Case against Killer Robots*, Human Rights Watch, United States of America, 2012, p. 2.

⁶ Predator RQ-1, Predator MQ-1, and Reaper MQ-9 are RPAS and UCAV.

⁷ Anti-aircraft systems (Aegis Combat System), anti-missile systems (Iron Dome), CIWS (Phalanx System), C-RAM (Centurion, Dutch Goalkeeper System) are examples of defensive and independent human-supervised AWS, which can select and engage target in accordance with the programmed. Human operators continue to carry out supervision in the weapons operation and can take over the weapons system if needed within a certain period of time.

⁸ Samsung Techwin SGR-A1, DoDaam’s Super aEgis II, Roeh-Yoreh (“Sees-Fires”), and Loitering Munitions; see also: United Nations General Assembly [“UNGA”], “Report of the Special Rapporteur on extrajudicial, summary or arbitrary execution,

and attack without interaction and input from humans.

The use of AWS in armed conflict will greatly affect the nature of future warfare. This has attracted the attention of Human Rights Watch (HRW). In November 2012, HRW released a report on "Losing Humanity: The Case against Killer Robots".⁹ This report contained criticisms against AWS and sparked important debate over the validity of excluding human operators during the decision-making process for a deadly attack.¹⁰

The impact of AWS lies in the decision of the attack taken by the robot itself, eliminating human decisions and actions in carrying out the execution of the attack.¹¹ Concerns are based on the task of machines or systems that make life or death decisions without human intervention.¹² Many examples illustrate that the more sophisticated a weapon, the more principles of IHL are sacrificed. On the other hand, sophisticated weapons and modern technology are expected to reduce casualties of civilians and combatants. Therefore, this article states that the use of AWS is in accordance with IHL principles as long as some IHL limitations are applied. Accordingly, a legally binding instrument is necessary to prevent this smart weapon from violating IHL principles.

B. THE USE OF AUTONOMOUS WEAPON SYSTEMS UNDER INTERNATIONAL HUMANITARIAN LAW

Dr. Armin Krishnan stated that the Killer Robot or AWS has intelligence that allows it to actively search targets and has abilities to make decisions to kill or not to kill its targets.¹³ Basically, technology in weapons is neutral and does not have preferences on friends or foe, however human involvement in design and development determines the weapon technical aspect during war as reflected in the term "guns don't kill people, people kill people".¹⁴ However, AWS has challenges within its use, such as:¹⁵

- a) AWS does not have a human quality judgment to assess a person's intent (a threat or not).
- b) The number of scenarios will disrupt AWS ability to analyze and comply with the provisions of proportionality. Proportionality in an attack must be determined subjectively based on a case-by-case basis.
- c) AWS is vulnerable to hacking and it could be used by non-State actors (cartels or individuals) against the State, other non-State actors, or civilians.
- d) Identifying enemies that have become *hors de combat* could be challenged since it requires human judgment to determine whether the target was injured, needed medical treatment, or faked an injury.

Thus, AWS must comply with IHL's key principles as means of warfare in response to criticism on the deployment of AWS. The

Christof Heynes", *Human Rights Council*, A/HRC/23/47, 9 April 2013, p. 8-10; Maya Brehm, *Defending the Boundary: Constraints and Requirements on the Use of Autonomous Weapon Systems under International Humanitarian and Human Rights Law*, The Geneva Academy of International Humanitarian Law and Human Rights, Geneva, 2017, p. 16-8.

⁹ Michael N. Schmitt and Jeffrey S. Thurnher, "'Out of Loop': Autonomous Weapon Systems and the Law of Armed Conflict", *Harvard National Security Journal*, Vol. 4, 2013, p. 231.

¹⁰ *Ibid.*

¹¹ UNGA, *Op.cit.*, p. 5.

¹² Convention on Certain Conventional Weapon (CCW) Meeting of High Contracting Parties, "Report of the

2015 Informal Meeting of Experts on Lethal Autonomous Weapons Systems (LAWS)", CCW/MSP/2015/3, Geneva – Switzerland, 12-13 November 2015, para. 13.

¹³ Armin Krishnan, *Killer Robots: Legality and Ethicality of Autonomous Weapons*, Ashgate Publishing Limited, Surrey, 2009, p. 33.

¹⁴ Andrew Feenberg, "What is Philosophy of Technology?", available at: https://www.sfu.ca/~andrewf/books/What_is_Philosophy_of_Technology.pdf (accessed on 26 January 2019).

¹⁵ HRW and IHRC, *Losing Humanity: The Case against Killer Robots*, *Op.cit.*, p. 30-6; see also: UNGA, "Report of the Special Rapporteur on extrajudicial, summary or arbitrary execution, Christof Heynes", *Op.cit.*, p. 18.

description below will analyze whether the use of AWS in armed conflict is in accordance with the IHL principle of law.

1. Principle of Military Necessity

The principle of military necessity is one of the core principles in armed conflict to ensure attacks or weapons generate minimum damage and injuries to the military.¹⁶ Military necessity permits subject to the law of war to apply any amount and kind of force effectively and efficiently.¹⁷ Attacks must be directed at legitimate targets using effective military resources and there is no room for errors.¹⁸

AWS has a significant role in military weaponry and performs a solution on poor human judgment that is influenced by their emotions. The use of AWS can increase the strength of armed forces in the military operation in aspects of speed, agility, accuracy, persistence, range, coordination and greater mass, which is hard for humans to match such superiority.¹⁹ Until now, AWS still unable to replace humans on the battlefield, but it is used to reduce human forces on a life-threatening situation, such as checkpoints that are prone to suicide bombers.

AWS is different from other sophisticated weapons in terms of advantages.²⁰ Weapons with autonomous systems can increase efficiency in military operations and

reduce the negative effect of war. Its advantages start from reducing excessive damage, increasing military mission success, and reducing the risk of civilian and military casualties. The use of AWS can weaken the enemy's military power and launch the attack immediately with the minimum risk of military resources that contributes to significant military advantages.²¹ Military in every operation always considers the safety of its soldiers, differences between humans and machines are machines cannot "die". As a result, there are no sacrifices for suicide missions and could operate in a harsh environment. For example, seeing the condition of barbed wire and an armed guard at the target perimeter, AWS could perform a precision attack with minimum risk of military casualties.

Potential damage will definitely occur when using all types of weapons, AWS or semi-AWS. The fundamental difference between the two systems lies in the level of human intervention and need time to make a decision to launch an attack or defend in critical situations.²² Weapon information processing operating systems have a speed that is difficult for humans to match in terms of understanding, assessment, and decision-making process. The advantages of AWS can be seen in several military operations scenarios such as quick response attack or defense in a threatening

¹⁶ Viola Vincze, "Taming the Untameable: The Role of Military Necessity in Constraining Violence", *ELTE Law Journal*, Vol. 2, 2016, p. 94.

¹⁷ Weapons Law Encyclopedia, "Necessity", available at: <http://www.weaponslaw.org/glossary/necessity-definition-under-international-law> (accessed on 3 July 2019).

¹⁸ Yishai Beer, "Humanity Considerations Cannot Reduce War's Hazards Alone: Revitalizing the Concept of Military Necessity", *European Journal of International Law*, Vol. 26, No. 4, 2016, p. 805.

¹⁹ Paul Scharre, "The Opportunity and Challenge of Autonomous Systems", on Andrew P. Williams and Paul D. Scharre (eds.), *Autonomous Systems: Issues for Defence Policymakers*, *Autonomous Systems: Issues for*

Defence Policymakers, NATO Headquarters Supreme Allied Commander Transformation, Virginia, 2015, p. 3.

²⁰ Nathan Leys, "Autonomous Weapon Systems and International Crisis", *Strategic Studies Quarterly*, Vol. 12, No. 1, 2018, p. 55.

²¹ Luke A. Whitemore, "Proportionality Decision Making in Targeting: Heuristics, Cognitive Biases, and the Law", *Harvard National Security Journal*, Vol. 7, 2016, p. 590-1.

²² Raine Sagrainsingh, "Lethal Autonomous Weapons Systems: Artificial Intelligence and Autonomy", *Journal of Engineering and Public Policy Washington Internships for Students in Engineering*, Vol. 22, 2018, p. 33.

situation and operation can still be carried out by the time communication between weapons and humans is interrupted or cannot be connected.²³

2. Principle of Humanity

AWS main issues are related to the principle of humanity are based on the concern of excessive injury, unnecessary suffering and weapon reliability.²⁴ This principle is one of the first and main objectives that must be carried out by all parties to the conflict since war is well known for its devastating effect on human life and properties. To reduce the impact on human life, high-technology weaponry is needed as a means of warfare. The comparison can be seen in the United States (U.S.) Central Intelligence Agency drone program in Pakistan.²⁵ Political scientist Avery Plaw concluded that the ratio of civilian casualties to drone attacks is only twenty percent, whereas conventional military conflict is estimated to have resulted in thirty to eighty percent of civilian casualties. Thus, the use of drones (smart weapons) is better in fulfilling humanitarian principles considering the fact that there are fewer civilian deaths compared to the traditional means of warfare.

The principle of humanity must be formed on a case-by-case basis to determine whether an attack is excessive or not, based on the method and type of weapon. For example, Samsung SGR-A1 can be an alternative weapon with AWS technology using rubber bullet's "kinetic impact munitions" rather than live ammunition. Rubber bullets for sentry

weapon types is useful for paralyzing individual enemies but not killing or injuring excessively. Thus, the paragraph below will analyze AWS capabilities based on the principle of distinction and proportionality.

a. Principle of Distinction

Article 51 of AP I stated that civilians must be protected against all threat during military operations and prohibit direct attacks without distinguishing between civilians and combatants. International Court of Justice (ICJ) through its 1996 Advisory Opinion on the Legality of Nuclear Weapons stated that the principles and provisions in armed conflict on the basis of humanity are subject to certain conditions, in this case, means of war which preclude any distinction between civilian and military targets or cause unnecessary suffering are prohibited.²⁶ Prohibition against indiscriminate attack derives from the principle of distinction. Indiscriminate attacks are:

- a) Attacks are not directed at specific military objectives.
- b) Weapons which cannot be directed to specific military targets.
- c) Means of warfare effects of which cannot be limited as required by IHL.

HRW Report did not consider AWS as a weapon that has the ability to distinguish civilians from combatants or military objects from civilian objects and HRW concludes that AWS is incapable to comply with IHL on the basis of inadequate human quality judgments.²⁷ There

²³ Paul Scharre, "Autonomous Weapons and Operational Risk", *Ethical Autonomy Project Center for a New American Security*, February 2016, p. 23.

²⁴ Article 35(2) Additional Protocol I ["AP I"].

²⁵ Kelly Cass, "Autonomous Weapons and Accountability: Seeking Solutions in the Law of War", *Loyola of Los Angeles Law Review*, Vol. 48, No. 1017, 2015, p. 1039.

²⁶ International Court of Justice ["ICJ"] Reports, Legality of the Threat or Use of Nuclear Weapons, Advisory Opinion of 8 July 1996, para. 95.

²⁷ Michael N. Schmitt, "Autonomous Weapon Systems and International Humanitarian Law: A Reply to the Critics", *Harvard National Security Journal Features*, 2013, p. 12; see also: HRW and IHRC, *Op.cit.*, p. 63.

are several things that can be considered in response to HRW concerns and other parties who refuse to use AWS. The following describes the worthiness of using AWS as means of warfare in accordance with the principle of distinction.

First, recent main equipment and weapon systems are more than just identifying individuals or objects. Modern sensors have changed the way war is fought with its ability to determine the object material, compile data from the acquired target, cut off communication lines, and identify individuals visually through AWS software. The ability of sensors lies from infrared cameras, heat sensors, and sensors that can detect visually from uniforms and weapons used by the military, which is supported by technological intelligence to detect military equipment such as tanks, artillery, military bases, and others. In certain cases, a weapon needs to be equipped with more than one sensor that supports each other to detect targets in various situations. For example, the *Suchzünder-Munition für die Artillerie* Precision-Guided Munition (PGM) 155mm has two sensors, namely, infrared sensors and millimeter wave radar sensors. Infrared sensors have limitations to perform in humid, fog, cloudy or smoke conditions, at that time, the millimeter wave radar sensor steps in such

conditions.²⁸ In addition, sensors can also work to detect threats in a short time and can attack targets effectively based on where the threat was launched. The use of various kinds of sensors as detection devices is one way to distinguish targets to be attacked.

Second, sensor capacity has a major contribution to detect military equipment in order to support AWS attack a "dual-use object", which is objects used for civilian and military purposes, for example, railroads and bridges that can be used as civilians connecting routes for civilians or alternate routes for military logistics distribution.²⁹ Basically, civilian objects lose their protection in the situation where military equipment is placed on civilian objects or distributed using civilian objects. Therefore, AWS can attack the target since principle of distinction does not protect civilian objects from military attacks when each objects which by their nature, location, purpose or use make an effective contribution to military action (legitimate military objective).³⁰

Third, weapons operation in some cases related to human error and causing an incident. As in the 1994 "friendly fire" incident, the U.S. Air Force F-15 pilot misidentified two U.S. Army Black Hawk UH-60 helicopters as Iraqi military forces which left 26 people dead.³¹ This case has shown that

²⁸ Department of the Army, *Engineering Design Handbook: Army Weapon Systems Analysis, Part Two*, US Army Materiel Development and Readiness Command, Virginia, 1979, p. 27-15; see also: NATO Advisory Group for Aerospace Research and Development, "Precision Guided Munitions: Technology and Operational Aspects", AGARD-CP-320, *Papers Presented at the Guidance and Control Panel 34th Symposium*, Norway, 4-7 May 1982, p. 10-10.

²⁹ XIXth International Red Cross Conference, *Draft Rules for the Limitation of the Dangers Incurred by the Civilian Population in Time of War*, ICRC, Geneva, 1956, Annex Article 7 paragraph 2.

³⁰ Article 52(2) AP I.

³¹ Peter B. Ladkin and Jörn Stuphorn, "Two Causal Analyses of the Black Hawk Shootdown during Operation Provide Comfort", available at: <http://rvs.uni->

errors did not occur technically, but involved human operators through complex military command and control structures involving technology systems.³²

Friendly-fire incidents or human errors on the battlefield are often affected by emotions and human perceptions that influence decision making. In contrast, AWS basically has no emotions and human perception, only relying on data information and sensors to measure the attack. The sensors possessed by weapons must be able to be relied upon to distinguish combatants and civilians. Humans have the same weakness as with sensors, which can violate the provisions of IHL with mistakes that are realized or miscalculated. Humans can be affected by stress, anger, and fear that make it easy to confront and trigger the violations of IHL.³³ Professor Marco Sassòli believes the criteria of IHL are objective criteria and that criteria could be entered into a computer program and it could be for autonomous weapon advantages and it will always do what humans programmed.³⁴ Sensor technology has the ability to distinct targets and therefore AWS can be deployed as long as it is used in a proper and reasonable manner.

b. Principle of Proportionality

Consideration in attacking targets must be assessed whether the attack was excessive in case of military advantages anticipated. Basically, IHL cannot prevent any losses as a consequence of war however every effort is made to avoid civilian casualties. Attack on civilian and civilian objects during an attack on a legitimate military target will be considered as collateral damage and must not be carried out excessively in relation to the concrete and direct military advantage anticipated.³⁵ In line with the provisions of Article 57(2)(a)(ii) Additional Protocol I (AP I) for selecting means and methods that can minimize damage and civilian casualties.³⁶

The significant role of AWS as a means of armed conflict does not disengage from its obligation to ensure dual use object targets. For objects that have a dual use function, IHL requires precautions and cancellations and delays if the target is not a military object or the attack has been detected will cause excessive loss of life and material for civilians.³⁷ This requires consideration based on a case-by-case basis to cancel an attack or give a warning if it will cause a fall in civilian casualties.³⁸ The description below is some precautionary measures that can be taken by

bielefeld.de/publications/Reports/ladkin-SCS03.pdf (accessed on 25 January 2019).

³² United States General Accounting Office, *Operation Provide Comfort: Review of U.S. Air Force Investigation of Black Hawk Fratricide Incident* (GAO/OSI-98-4), United States General Accounting Office, Washington, D.C., 1997, p. 2.

³³ Robin Geiß, *The International-Law Dimension of Autonomous Weapons Systems*, Friedrich-Ebert-Stiftung, Berlin, 2015, p. 14.

³⁴ ICRC, "New Technologies and Warfare. 7/9 Interview with Marco Sassòli", available at: <https://www.youtube.com/watch?v=im9U9KR68QI> (accessed on 28 April 2019).

³⁵ Article 57(2)(a)(iii) AP I; see also: Kenneth Anderson (et.al.), "Adapting the Law of Armed Conflict to Autonomous Weapon Systems", *International Law Studies*, Vol. 90, 2014, p. 403; *Prosecutor v. Stasilav Galić*, Judgement and Opinion, Trial Chamber I, ICTY, IT-98-29-T, 5 December 2003, para. 58.

³⁶ William H. Boothby, *Conflict Law: The Influence of New Weapons Technology, Human Rights and Emerging Actors*, T.M.C. Asser Press, The Hague, 2014, p. 114.

³⁷ Article 57(2)(a)(i), (ii), (b), and (c) AP I.

³⁸ Michael N. Schmitt, "Autonomous Weapon Systems and International Humanitarian Law: A Reply to the Critics", *Op.cit.*, p. 19-20.

military commanders and AWS weapons itself.

First, if the commander is faced with two distinct means of warfare to engage the target, one is more accurate than the other, is he required to use the more accurate one? Military commanders must use all precautionary measures to minimize damage to civilian objects and the loss of lives of civilians. In certain circumstances, weapons are not suitable to be placed in certain conditions considering it will affect weapon accuracy (e.g. environment and weather). In addition, military commanders are required to decide which munitions that do not lead to indiscriminate effects such as munitions containing nuclear, biological or chemical substances. Variants of various caliber ammunition, artillery munitions, and others were developed by the company following the development of various weapons technology.³⁹ The potential damage can be adjusted to the desired shot, depending on the munitions carried by the weapon. For example, PGM in various military operations is not suitable for densely populated areas or bombers with explosive weapons will cause greater damage compared to UCAV armed with bullets. Thus, the problem of excessive or not an attack all depends on the munitions, the propulsion method, the launch platform (land, ship, air), target, and distance. Military and humanitarian considerations through good faith and the military

commander assessment play an important role to be carried out effectively.⁴⁰ This is merely to anticipate civilian casualties.

Second, sensors contribute in assessing targets based on direct situation to deliver military advantages with minimum loss and damage.⁴¹ Professor Marco Sassóli stated that, logically, if AWS can distinguish targets from the beginning, AWS should be able to abort attacks when there are situational changes that have the potential IHL violation.⁴² The use of AWS must fit the environment and location where the weapon is operated, especially in urban and residential areas. Such weapons are placed in the battle zone (sea and air), as well as military areas – it can be a different matter. However, AWS can operate in the urban area with the prerequisite condition to cancel the attack on the possibility of civilian and civilian objects in the course of the attack. Therefore, AWS in autonomous drones must have a sensor and identification system that performs similar or better compared to RPAS technology.

3. Limitation and Restriction

Based on the analysis mentioned above, AWS is the latest technological breakthrough that has the potential to support the military performances in accordance with the principles of military necessity, humanity, distinction and proportionality. There are some limitations for AWS such as selecting munitions, effective and

³⁹ PT Pindad (Persero), "Munisi", available at: <https://www.pindad.com/ammunition> (accessed on 29 April 2019).

⁴⁰ John F. Murphy, "Some Legal (and a Few Ethical) Dimensions of the Collateral Damage Resulting from NATO's Kosovo Campaign", on Andru E. Wall (ed.),

Lethal and Ethical Lessons of NATO's Kosovo Campaign, *International Law Studies*, Vol. 78, 1998, p. 240-1.

⁴¹ Article 51(5)(b) and Article 57(2)(a)(iii) AP I.

⁴² Marco Sassóli, "Autonomous Weapon and International Humanitarian Law: Advantages, Open Technical Questions and Legal Issues to be Clarified", *International Law Studies*, Vol. 90, 2014, p. 337.

appropriate weapon positioning and give warnings or abort attacks if the system identifies civilians and civilian objects. Therefore, AWS is expected to be one of the weapons choices that can be used lawfully and effectively for military forces with the intent and purpose to minimize the loss of civilian lives and damage of civilian objects.

The existing IHL principles were used as guidance for means of warfare, including for AWS, but it does not easily tell us what is best to do in difficult situations.⁴³ These principles only serve as a guideline and make no attempt to elaborate in detail for AWS limitation in contemporary warfare. In order for AWS to make an effective contribution, regulations are also needed which regulate the technical use.

C. FUTURE REGULATION FOR THE USE OF AUTONOMOUS WEAPON SYSTEMS IN ARMED CONFLICT

Forming regulation regarding the development and use of AWS is a challenge in itself. There are many instruments regarding prohibition and restrictions on certain weapons such as prohibition and restrictions on specific weapons (chemical and biological weapons) based on international treaties⁴⁴ and customary international law⁴⁵ and general prohibitions and restrictions based on international treaties,⁴⁶ customary international law⁴⁷. However, there is no legal instrument that

contains provisions relating to AWS. The need for special regulation on AWS is the key for AWS to get its position as a means of warfare. The following is an explanation of the existing weapon review mechanism weak point based on Article 36 AP I and its urgency to form technical regulations.

1. "Weapon Review" Article 36 Additional Protocol I Weakness for Autonomous Weapon Systems

The existing mechanism for weapons and its features accommodated in Article 36 AP I, commonly referred to as "weapon review", assessing the legality of all weapons used. Article 36 AP I stated that States parties must ensure the development, possession or use of a new weapon is not prohibited in some or all circumstances by international law. Article 36 AP I is necessary to be complemented with Article 35 and Article 82 AP I which are beneficial to ensure the armed forces commit hostilities in accordance with IHL.⁴⁸

Article 36 AP I does not spell out the mechanism for the development or possession of new weapons. State parties assess whether new weapons are in accordance with IHL but the assessment by the state is invalid and ineffective internationally. Article 36 AP I require states to analyze each weapon that will be used at all time or only in certain circumstances but neglects the possibility of the weapon misuse.⁴⁹ As a result, various weapons

⁴³ Hugo Slim, *Humanitarian Ethics: A Guide to the Morality of Aid in War and Disaster*, Oxford University Press, New York, 2015, p. 44.

⁴⁴ 1868 St-Petersburg Declaration, 1925 Geneva Gas Protocol, 1972 Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on their Destruction, 1980 CCW, 1993 Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on their Destruction, Article 8(2)(b) paragraph (xvii) – (xx) Rome Statute 1998.

⁴⁵ Rule 72-86; see: Jean-Marie Henckaerts and Louise Doswald-Beck, *Customary International Humanitarian*

Law (Volume I: Rules), Cambridge University Press, Cambridge, 2005, p. 251-296.

⁴⁶ AP I Provision, particularly Article 36 AP I.

⁴⁷ Rule 11-14; see: Jean-Marie Henckaerts and Louise Doswald-Beck, *Op.cit.*, p. 37-50.

⁴⁸ ICRC, *A Guide to the Legal Review of New Weapons, Means and Method of Warfare: Measures to Implement Article 36 of Additional Protocol I of 1977*, ICRC Mines-Arms Unit, Geneva, 2006, p. 5.

⁴⁹ Yves Sandoz (et.al) (eds.), *Commentary on the Additional Protocols of 8 June 1977 to the Geneva Conventions of 12 August 1949*, Martinus Nijhoff Publishers, Geneva, 1987, para. 1469.

technical rules globally and left each country entirely makes its own assessment. These differences can arise from the fundamental aspect, for example, "autonomous" systems definition. The United Kingdom (UK) defined "autonomous systems" as a system that has the ability to observe its environment and make a decision on an attack in a series of alternative options without human supervision and control.⁵⁰ The UK definition is more focused on Phalanx weapons as human-supervised AWS. Thus, the UK has a narrower understanding than the AWS definition according to the U.S.,⁵¹ all weapons with such systems that can attack targets without human intervention.⁵² The difference generates ICRC concern when countries are incapable of properly assessing a new weapon or weapon of the future.⁵³

Dr. Vincent Boulanin affirms that "only few countries – less than 20 – have formal mechanisms related to the review of new weapons in accordance with Article 36 of AP I."⁵⁴ Developed countries have preferences implementing its military strategy relating to their national interests. Another issue that occurs is the lack of understanding of the requirements needed to assess new weapons, as well

as a lack of resources such as financial, legal and technical experts. Many countries without hesitation entrust the legality of weapons acquired from the manufacturers.⁵⁵ Weapon review must be framed internationally to ensure that AWS is developing, producing, deploying and using in accordance with the provisions of international law and specifically IHL.

2. Establishment of Specific Regulations regarding Autonomous Weapon Systems along with Technical Annex

The most suitable legal instrument in regulating and setting standards for the development and use of AWS is establishing additional Convention on Certain Conventional Weapon (CCW) Protocol. Adding Protocol on the CCW is the potential legal instrument in setting standards and considered the reasonable procedure in accommodating new weapons technology. The establishment of CCW Protocol I-III until Protocol V to the 1980 CCW on Explosive Remnants of War (Protocol V to the 1980 CCW) signifies the dynamic development of CCW with weapons technological advancement.⁵⁶ However, the CCW has advantages and disadvantages which lie in the number of high contracting parties.⁵⁷ The CCW held annual

⁵⁰ United Kingdom Ministry of Defence, *The UK Approach to Unmanned Aircraft Systems*, Joint Doctrine Note 2/11, The Development, Concepts and Doctrine Centre, Shrivenham, 30 March 2011, para. 205.

⁵¹ United States of America Department of Defense Directive, *Autonomy in Weapon Systems*, Number 3000.09, 21 November 2012, p. 13-4.

⁵² James Farrant and Christopher M. Ford, "Autonomous Weapons and Weapon Reviews: The UK Second International Weapon Review Forum", *International Law Studies*, Vol. 93, 2017, p. 396.

⁵³ Thompson Chengeta, "Are Autonomous Weapon Systems the Subject of Article 36 of Additional Protocol I to the Geneva Conventions?", *UC Davis Journal of International Law and Policy*, Vol. 23, No. 1, 2017, p. 69-70.

⁵⁴ Stockholm International Peace and Research Institute ["SIPRI"], "Implementing Article 36 Weapon Reviews in the Light of Increasing Autonomy in Weapon Systems", available at: [https://www.sipri.org/media/press-](https://www.sipri.org/media/press-release/2015/implementing-article-36-weapon-reviews-light-increasing-autonomy-weapon-systems)

[release/2015/implementing-article-36-weapon-reviews-light-increasing-autonomy-weapon-systems](https://www.sipri.org/media/press-release/2015/implementing-article-36-weapon-reviews-light-increasing-autonomy-weapon-systems) (accessed on 16 February 2019).

⁵⁵ Vincent Boulanin, "Implementing Article 36 Weapon Reviews in the Light of Increasing Autonomy in Weapon Systems", *SIPRI Insights on Peace and Security*, No. 2015/1, 2015, p. 17.

⁵⁶ Kari Kahiluoto, "European Union General Statement at the Third Review Conference of States Parties to the Convention on Certain Conventional Weapons", *Third Review Conference of States Parties to the CCW*, Geneva – Switzerland, 7-17 November 2006, p. 2-3.

⁵⁷ The Convention on Certain Conventional Weapons currently has a total of 125 States parties and 4 signatories (updated as at 14 November 2018); see: United Nations Office at Geneva, "High Contracting Parties and Signatories", available at: [https://www.unog.ch/80256EE600585943/\(httpPages](https://www.unog.ch/80256EE600585943/(httpPages)

meetings involving not only state parties, but also all countries, international organizations, and non-governmental organizations. The main issue is that state parties negotiations failed to yield an agreement consensus on the addition of CCW Protocol and the states have a negative tendency in compliance commitment. The formation of new conventions is necessary if the mechanism process is considered time-consuming or some countries have objected to the proposal on the addition of a new protocol. Therefore, the addition of the CCW Protocol is promising since CCW has established Group Governmental Experts (GGW) to lead the negotiation process in response to the problems in finding solutions on AWS lack of rigid rules and have involved various stakeholders.⁵⁸ In the 2018 GGE Report on Lethal Autonomous Weapon Systems, there are six stages of procedure on a new weapon beginning with the political discussion, weapon development, production, test, deployment, to post-use assessment.⁵⁹ The six phases are simplified into three, namely: the research and development (R&D); weapon test, evaluation, and verification; and deployment and use. Following is a concept of three stages of human-machine interaction in forming AWS standard.

a. Strengthening Autonomous Weapon Systems Standard through Three Stages of Human-Machine Interaction

New weapons will proceed through various stages of human-machine interaction before they can be used consistent with their capabilities. Interdisciplinary approach must involve in the process with an expert in legal, military, health, weaponry, and environmental which in each phase will have a different scope of regulation. International treaty law is unable to cover all the rules in detail and technical, therefore national law and industrial standard provisions have to complement it. However, the state must ensure that its provisions must be in line with the existing weapons law. Weapons must be approved and assessed for its legality in the process of development, possession, production, modification, and use based on the laws of armed conflict, national law, and international law.⁶⁰

1) Research and Development Phase

The Protocol must be completed with a Technical Annex to give objectives detail to execute the articles of the Protocol. Technical Annex must be a standard during the weapons R&D, production, and test period. The implementation of the Technical Annex is voluntary as the guidance for the state parties

)/3CE7CFC0AA4A7548C12571C00039CB0C?OpenDocument (accessed on 23 May 2019).

⁵⁸ Fifth Review Conference of the High Contracting Parties to the CCW, "Report of the 2016 Informal Meeting of Experts on Lethal Autonomous Weapons Systems (LAWS)", CCW/CONF.V/2, Geneva – Switzerland, 12-16 December 2016, Annex, p. 14; see also: Bonnie Docherty (et.al), "Humanitarian Disarmament: The Way Ahead", *Armed Conflict and Civilian Protection Initiative, the Harvard Humanitarian Initiative, and the Harvard Kennedy School's Carr Center for Human Rights Policy Conference Summary*

Harvard Law School, Cambridge – United States of America, 5-6 March 2018, p. 7

⁵⁹ Group of Governmental Experts of the High Contracting Parties to the CCW, "Report of the 2018 Session of the Group of Governmental Experts on Emerging Technologies in the Area of Lethal Autonomous Weapons Systems", CCW/GGE.1/2018/3, Geneva – Switzerland, 9-13 April 2018 and 27-31 August 2018, p. 4; see also: Agenda item 6 (b).

⁶⁰ United States Department of the Air Force, Legal Review of Weapons and Cyber Capabilities, Air Force Instruction 51-402, 27 July 2011, para. 1.1.1.

much like the Protocol V to the 1980 CCW.⁶¹ Meanwhile, industrial standards and national law can complete with the technical annex if there are provisions that need to be deemed necessary to be regulated. The weapon R&D has the potential as domestic law enforcement equipment. For example, Riot Control Agents definition is accommodated on the 1992 Chemical Weapons Convention which is prohibited from being used as a means of warfare but is legal to use and possess the weapon as riot control equipment for domestic law enforcement.⁶² AWS actually can operate in the course of the national defense system and offensive means of warfare for the purpose of attack, defense, and control of the masses.

There are several factors that need to be considered during R&D to ensure that AWS does not have the potential to violate IHL. Before entering mass production, assessment must be carried out at the concept/design stage and technology development (through prototype testing).⁶³ An example of comparison is the Maneuvering Characteristics Augmentation System (MCAS) technology on the Boeing 737 MAX which caused two fatal incidents and killed 346 people in less than six months. The Federal Aviation Administration has not

issued a final investigation report regarding the MCAS issue. Aviation stakeholders submitted initial reports related to the causes of the accident such as Boeing major design flaws, manufacturers only gave bare minimum of information and training regarding new technology to operator and pilot, as far as the indication of bias certification process.⁶⁴ Therefore, the state must understand and learn the sophisticated nature of the weapon produced on AWS weapons or manufacture improvements on several previous weapon designs. States must establish clear and structured technical regulations before a weapon is operating to avoid such mistakes.

Technological innovation on R&D must introduce the "kill switch" function for such weaponry, which switches off the weapon main operation function. The presence of the technology is not designated for humans to intervene in system decision making. Kill switch function only used following an incident due to design flaws, weapon malfunctions, and threatened the national security or breach the military protocol, specifically on the irresponsible hands. Kill switch function activation is determined based on an "ethical black box"⁶⁵ to record

⁶¹ Preamble Technical Annex Protocol V to the 1980 CCW.

⁶² Stuart Casey-Maslen, Neil Corney, and Abi Dymond-Bass, "The Review of Weapons under International Humanitarian Law and Human Rights Law", in Stuart Casey-Maslen (ed.), *Weapons under International Human Rights Law*, Cambridge University Press, Cambridge, 2014, p. 416; see also: Organisation for the Prohibition of Chemical Weapons, "What is a Chemical Weapon?", available at: <https://www.opcw.org/our-work/what-chemical-weapon> (accessed on 18 February 2019).

⁶³ Marco Sassòli, *International Humanitarian Law: Rules, Controversies, and Solutions to Problems Arising in*

Warfare, Edward Elgar Publishing Limited, Gloucestershire, 2019, para. 10.90.

⁶⁴ RSL Holdings, "Implications of the Boeing 737 MAX Problem for Autonomous Vehicle Design", available at: https://rslholdingsinc.com/wp-content/uploads/2019/03/RSL-Patent-Offering-Supplemental-Note_3-19-19.pdf (accessed on 27 April 2019).

⁶⁵ Identical to Flight Data Recorder; see: Alan F. T. Winfield and Marina Jirotko, "The Case for an Ethical Black Box", in Yang Gao (et.al) (eds.), "Towards Autonomous Robotic Systems", 18th Annual Conference

the sensor activity and internal system of the weapon.

2) Test, Evaluation and Verification Phase

Weapons will have to proceed on weapon testing, evaluation, and verification following the R&D stage. At this stage, potential errors on design flaws can be detected and regularly evaluated to ensure the system functions operate safely and effectively. Identification of weapon weaknesses must be resolved to minimize or eliminate the potential incidents on the operations.⁶⁶ Optimal test procedure and evaluations allow primary identification for potential error and make continuous improvement since humans are responsible for forming a reliability system.

A weapon is just like an aircraft, made up of many individual components parts. Components produced by more than one manufacturer must be carried out for test and evaluation in stages (e.g. sensor technology, ammunition, computing and information system, and software capabilities). After gaining certification and approval for installation, the components are assembled into a single weapon device. Weapon testing must be conducted in various conditions of battlefields to ensure weapons operation in accordance with the provisions of IHL. Therefore, the final phase at the test and evaluation phase is the certification issued by the manufacturer and states.

3) Weapon Use and Deployment

AWS must be determined by international treaty law in the form of articles within the phase of use and development. The outcome in the CCW Protocol does not prohibit AWS. In contrast, the CCW Protocol stipulates AWS in accordance with the IHL corridor. There are several provisions that must be accommodated through articles of the CCW Protocol, namely:

- a) The prohibition to deploy and use AWS on a dual-use object in densely populated areas (principle of proportionality);
- b) Make a warning if the target indicated the presence of civilian (principle of precaution);
- c) The weapon must treat the target as a civilian and civilian object on the uncertain military object (principle of distinction);
- d) Military commanders must ensure the exact type of weapon and munitions capabilities fit their designation, such as prohibiting the use of high explosive munitions in densely populated areas (principle of military necessity);
- e) In the event of weapon malfunction or design flaws that endanger civilians, state must halt the weapon operation and completely lock the operation function through the kill switch function; and
- f) All restrictions must be in accordance with the

TAROS 2017, Guildford – United Kingdom, 19-21 July 2017, p. 262.

⁶⁶ Harold E. Price (et.al), "The Contribution of Human Factors in Military System Development:

Methodological Considerations", *U.S. Army Research Institute for the Behavioral and Social Science*, Technical Report 476, 1980, p. 2-13.

provisions and principles of IHL.

Legal standards based on the CCW Convention in its Preamble and Article 1-11 of the Convention will be used in problem-related to ratification process and state compliance. However, all states can take references to CCW Protocol on AWS, primarily for developing states' lack of resources to conduct weapons assessments. The encouragement in ratifying the protocol needs a long period of promotion and diplomacy to convince the state to make the Protocol a parameter in the use of AWS and standardization on development, research, and weapon testing.

Parameters for standardization on development, research, test, and use of AWS must be determined. Specific instruments governing AWS in the form of CCW Protocol must be formed immediately as parameters in their use to reduce incident, unnecessary suffering, and war crimes. The provision is to set international standards and limits for the development and use of AWS, rather than to prohibit. It is preferable to provide specific regulation to respect IHL provision rather than prohibit its use or development, based on two reasons: first, technological development helps the manufacturer to produce weapons easily; second, mass production without the international provision on the standard will cause potential danger and the threat of misuse. AWS 'great potential gives countries a huge advantage in hostilities despite hard to predict whether AWS could be one of means of warfare. Therefore, it is preposterous to prohibit the use

and development of AWS for the sake of future weapon technology. It should be a collective responsibility to provide suitable and multilateral regulation through discussion.

D. CONCLUSION

AWS is a huge leap in the military weapons system that potentially exceeds human capabilities. However, this fact is not sufficient to absolutely ban the use of AWS. Its features have better coverage on rough area operation (i.e. narrow passes, precipitous heights, positions at a great distance from the enemy). AWS is supported by various sensors and advanced technology to be able to support military operations while also increasing civilian safety. To support the sensor, military commanders must select the exact munitions to minimize the effect or impact of the destruction. Therefore, for as long as AWS is capable to suspend or cancel an attack in the case that the sensor and information collected detect the target as civilians or civilian objects, the use of AWS cannot be prohibited. All conventional weapons basically could bring advantage or damage, depending on the user. With proper weapon's standards and limitations, AWS will develop into a smart weapon that supports the armed forces in winning the war whilst also protecting those who are not/no longer targets in IHL.

For as long as standards and limitations of AWS are concerned, the future regulation shall provide technical provisions concerning development, production, ownership, the use and transfer of AWS during an armed conflict. This article further suggests that CCW Protocol and Technical Annex are the proper form international instruments for AWS.

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