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I. INTRODUCTION

The Convention on Certain Conventional Weapons ("CCW") is a treaty based upon the principles of international law that weapons used for engagement in armed conflict should not cause unnecessary injury and suffering.[1] Eighty-two states are party to this treaty and continue to negotiate and ratify additional protocols that ban the use of specific weapons.[2] In May 2014, the CCW held its first meeting on the topic of Lethal Autonomous Weapon Systems ("AWS").[3] The specific mandate of the meeting was to discuss emerging technologies in the area of AWS, and was generally regarded as a preliminary discussion, in an area of rapid technological change.[4] Another meeting was held in April 2015.[5]

During the 2014 meeting, sessions were held on the ethical, sociological, military, and legal aspects of AWS, which included technical aspects on how to define autonomy and how autonomy can be measured. Amongst this discussion was the idea of adopting the treaty language of "meaningful human control" ("MHC") as a way to measure autonomy and/or regulate AWS.[6] The purpose of this paper is to question the concept of MHC and how it may or may not be a useful legal tool for regulating AWS.

Part II of this paper will provide a working definition of autonomy for the sake of creating a common understanding within this paper. It will then explain the current status of AWS technology and what possibilities the future holds for autonomy. Part III will discuss state reactions to MHC and the current legal system that already regulates AWS. Part IV will then critique what it may mean for states to comply with MHC and what challenges may be presented by implementation through taking a closer look at the "human control" in MHC. Part V of

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1 Convention on Prohibitions or Restrictions on the use of Certain Conventional Weapons Which May be Deemed to be Excessively Injurious or to have Indiscriminate Effects as Amended on 21 December 2001 Preamble, Dec. 21, 2001,19 I.L.M. 1523,1524.

2 United Nations Treaty Collection, Status of Amendment to Article I of the Convention on Prohibitions or Restrictions on the Use of Certain Conventional Weapons which may be deemed to be Excessively Injurious or to have Indiscriminate (last visited Jan. 5, 2016), https://treaties.un.org/pages/ShowMTDSGDetails.aspx?src=UNTSONLINE&tabid=2&mtdsg_no=XXVI-2-c&chapter=26&lang=en#Participants.

3 Informal Meeting of Experts on Lethal Autonomous Weapons Sys. (LAWS), May 13-16, 2014, *Report* ¶ 13-16 CCW/MSP/2014/3 (June 11, 2014).

4 *Id.*

5 Informal Meeting of Experts on Lethal Autonomous Weapons Sys. (LAWS), May 13-16, 2014, *Revised Annotated Programme of Work*, CCW/MSP/2015/WP.1/Rev.1 (Mar. 11, 2015).

6 *Supra* note 3, at ¶ 20.

this paper will analyze the "meaningful" aspect of MHC, and to what degree humans can, will, or should delegate tasks to autonomous systems. Theories of automation bias, automation complacency, and their role in the field of AWS as well as other fields will be discussed. Part VI will offer concluding remarks on why MHC appears useful because of its simplicity, but fails to be useful in application because of its vagueness.

II. DEFINING AUTONOMOUS WEAPON SYSTEMS

a. Definitions and Distinguishing Autonomous from Automated

There is no internationally agreed upon meaning for AWS, but there are working definitions that may be used as guidance for developing legal analysis within this paper. At a recent International Committee of the Red Cross ("ICRC") meeting regarding the issue, AWS were defined as, "weapons that can independently select and attack targets, i.e. with autonomy in the 'critical functions' of acquiring, tracking, selecting and attacking targets."[7] This was the definition used at the ICRC meeting that included representatives from 21 states, along with 13 independent experts.[8] The U.S. Department of Defense ("DoD") has more specifically defined an AWS as,

> [A] weapon system that, once activated, can select and engage targets without further intervention by a human operator. This includes human-supervised autonomous weapon systems that are designed to allow human operators to override operation of the weapon system, but can select and engage targets without further human input after activation.[9]

The DoD definition emphasizes the role of the human in defining autonomy, but both definitions help give an outline of what autonomy means, which will be necessary for the discussion below on regulation. The definition cited is specific for what may be considered *fully-autonomous* weapon systems, but the DoD also distinguishes *semi-autonomous* weapons systems and *human-supervised* autonomous weapon systems. The semi-autonomous weapons system is a system that once activated is intended only to "engage individual targets or specific

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[7] INT'L COMM. OF THE RED CROSS, AUTONOMOUS WEAPON SYSTEMS: TECHNICAL, MILITARY, LEGAL AND HUMANITARIAN ASPECTS 7 (2014).

[8] *Id.*

[9] U.S. DEP'T OF DEF., DIRECTIVE 3000.09: AUTONOMY IN WEAPON SYSTEMS, 13-14 (2012), *available at* http://www.dtic.mil/whs/directives/corres/pdf/300009p.pdf.

target groups that have been selected by a human operator."[10] The distinction between the semi-autonomous and the fully autonomous is the actual *selection* of the targets. The human-supervised autonomous weapons system is designed to "to provide human operators with the ability to intervene and terminate engagements, including in the event of a weapon system failure, before unacceptable levels of damage occur."[11] Under the DoD definition, human-supervised AWS are a type of AWS, but not all AWS must be human-supervised to fit within the definition of AWS.

In continuing to develop a definition, it is important to note that AWS are distinct from automated weapons systems. While often confused, the difference is that an automated weapon system is designed to attack a target once a pre-determined parameter has been breached, while an autonomous weapon system can attack a target which it selected independently.[12] Both systems can operate without human involvement, but AWS have the ability to select their own targets, rather than simply attacking under only pre-defined conditions. A landmine triggered by pressure would be a simple example of an automated weapon system, while more modern examples include sentry guns, sensor-fused ammunition, and most cruise missiles.[13] Such a distinction is important when it comes to understanding MHC because it raises questions of what "human" means within MHC. There may already be automated systems that are considered acceptable that do not have human involvement, so what will this mean in terms of autonomous systems?

In addition to being distinct from automated weapon systems, AWS are not to be confused with remotely piloted systems (i.e. an unmanned aerial vehicle ("UAV") or "drone"). When a UAV is under pilot control, it is not autonomous. Even if an in-flight UAV were to lose its communication link with the ground-based pilot and have a set of pre-programmed flight instructions to follow, that would make the aircraft automated, but still not autonomous.[14] The distinction of autonomy between the two systems creates different legal issues for AWS than those of automated weapon systems.

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[10] *Id.*

[11] *Id.*

[12] Alan Backstrom & Ian Henderson, *New Capabilities in Warfare: An Overview Of Contemporary Technological Developments And The Associated Legal And Engineering Issues In Article 36 Weapons Reviews*. 94 INT'L REV. OF THE RED CROSS 483, 488 (2012).

[13] Markus Wagner, *The Dehumanization of International Humanitarian Law: Legal, Ethical, and Political Implications of Autonomous Weapon Systems*, 47 VAND. J. TRANSNAT'L L. 1371, 1382-83 (2014).

[14] OFFICE OF THE SEC'Y OF DEF., UNMANNED INTEGRATED SYSTEMS ROADMAP 15 (2013).

At points, this paper will discuss some of the legal issues that relate to automated weapons systems which, while different from autonomy, are still important in the discussion of AWS because of the way that automation and autonomy can be thought of as falling on a spectrum. However, even if automation and autonomy are viewed on a spectrum, it is still important to distinguish and draw a line at some point for purposes of legal regulation. Therefore, the line of distinction drawn for the purpose of this paper will be the AWS definition used by the DoD.

b. Review of Current Developments of AWS

The United States, along with a handful of other countries, has had a dramatic increase in the number of UAVs that have been purchased and have been in use by the military in the past 15 years. This is in part from the demand that was created by the Iraq and Afghanistan wars, developments in communication and navigation technologies, and the benefit of a lowered risk to pilots.[15] As evidenced by continued investment for research and development, governments have been generally supportive of this technology because of its reduction of casualties and lower operational costs.[16] Currently, autonomous and remote-controlled capabilities support unmanned systems with the intention to, "free warfighters from the dull, dirty, and dangerous missions that might now be better executed robotically and enable entirely new design concepts unlimited by the endurance and performance of human crews."[17] Some scholars explain that modern military forces are driven in the direction of automation and autonomy because of factors such as the increasing complexity of military technology, the speed of modern weapons, and the need for an immediate response to threats after evaluating vast amounts of information.[18] Additionally, because remote-controlled operations require a direct communication link, autonomy is arguably a direction the military needs to move in as a matter of necessity in case of communication link failure.[19]

However, many would not consider the UAVs in use today to be autonomous because they are remotely controlled by a pilot, and require

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[15] JEREMIAH GERTLER, CONG. RESEARCH SERV., R42136, U.S. UNMANNED AERIAL SYSTEMS 1-2 (2012).

[16] *Id.* at 2-3.

[17] OFFICE OF THE SEC'Y OF DEF., UNMANNED INTEGRATED SYSTEMS ROADMAP 34 (2007).

[18] Jack M. Beard, *Autonomous Weapons and Human Responsibilities*, 45 GEO. J. INT'L L. 617, 624-625 (2014).

[19] *Id.*

constant support and control from a ground crew.[20] This would not rise to the level of fulfilling the DoD fully-AWS definition of a machine that "once activated, can select and engage targets without further intervention by a human operator."[21] Nonetheless, because of advances in technology, others will argue that there are currently fully autonomous weapons in existence. One example of such a weapon is the Israeli HARPY UAV-based weapons system, which is a fire-and-forget weapon system that can loiter for several hours before detecting, locking-on to, and destroying enemy radars.[22] It could arguably be considered autonomous because there is no further human input after it is fired. However, while these weapons are still in the realm of automated weapon systems, they are cannot be classified as autonomous because they select targets under a set of pre-defined conditions.

Some autonomy has been achieved in the refueling procedures between two high-altitude unmanned aircraft. The refueling was done at 45,000 feet between a NASA Proteus aircraft and a Northrop Grumman Global Hawk, and the Global Hawk demonstrated its ability to receive fuel autonomously.[23] This is still a very small degree of autonomy and is described by the DoD as "autonomous execution," representing the autonomous system's ability to keep an aircraft in flight by compensating for small disturbances it finds on a preprogrammed path.[24] While this may be described as "autonomous execution," under the DoD's Directive 3000.09, this does not meet the definition for AWS because it cannot "select and engage targets without further intervention from a human operator" once it has been activated.[25] Neither would it fit under the DoD's requirements for a semi-autonomous weapons system because the degree of autonomy that has been obtained is still not related to the selection of targets.[26]

With respect to the current development of autonomous technology, there are also issues of operational usefulness and cost. There is criticism that the MQ-9 Reaper may be more expensive than the benefits received from it, despite its popularity with the public, Congress, and the DoD.[27] Criticisms include that the MQ-9 Reaper has a high cost to acquire and

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[20] GERTLER, *supra* note 15, at p. 13 n. 48 .

[21] AUTONOMY IN WEAPON SYSTEMS, *supra* note 9.

[22] ANTHONY FINN & STEVEN SCHEDING, DEVELOPMENTS AND CHALLENGES FOR AUTONOMOUS UNMANNED VEHICLES : A COMPENDIUM 178 (Springer, 2010).

[23] *Landmark Flight Moves KQ-X Program Toward Unmanned Aerial Refueling*, DEF. DAILY (Mar. 9, 2011).

[24] UNMANNED INTEGRATED SYSTEMS ROADMAP, *supra* note 14, at 66.

[25] AUTONOMY IN WEAPON SYSTEMS, *supra* note 9, at 14.

[26] *Id.*

[27] Winslow T. Wheeler. *MQ-9 Reaper Drone: Not a Revolution in Warfare*, COMMON DEF. Q., Summer 2012 at 27, 29.

operate, it only has a limited weapons payload, and cannot survive even minimal air defense. Much of the higher costs to operate come from the extensive infrastructure that is required such as a manned ground control station, a satellite link, and a local control unit for takeoff and landings, many of which are costs that would not exist for a manned aircraft.[28] While political considerations may determine decisions for military funding, theses sorts of costs may also factor into future decisions in the development of automated and autonomous weapon technology.

c. Future of AWS

In contrast to its "autonomous execution" goals, the DoD hopes to move further from automation toward autonomy in what it refers to as "autonomous performance."[29] The concept of "autonomous performance" includes a system programmed with algorithms to integrate sensing, perceiving, analyzing, communicating, and planning so that the system can eventually learn to make decisions for itself in-line with the pre-assigned mission.[30] These are all factors that will require less human intervention in the operation of weapons systems. For example, it is possible to imagine one integrated system that would manage multiple aircraft in flight for coordinating formations and maneuvering, and therefore reduce the need for pilots and crew.[31]

Within the foreseeable future, it is not likely that the technology will develop for autonomous weapons to independently determine their own actions and make complex decisions to adapt to their environment, but for the sake of discussion, the assumption will be made that it is possible at *some* point in the future.[32] As one example, the current automatic targeting capabilities of weapons only work in low-clutter environments such as a ship at sea, but not in medium or high-clutter environments. The challenges of developing autonomous technology comes from the difficulty in programming a system for so many unforeseen factors that can arise in warfare.[33] Despite the difficulties in development, there is still a need to consider the future implications of the law on such machines, and MHC has been proposed as a way to govern these questions.

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28 *Id.* at 27-28.

29 UNMANNED INTEGRATED SYSTEMS ROADMAP, *supra* note 14, at 66.

30 *Id.*

31 *Id.* at 71.

32 AUTONOMOUS WEAPON SYSTEMS: TECHNICAL, MILITARY, LEGAL AND HUMANITARIAN ASPECTS, *supra* note 7, at 16.

33 *Id.* at 30.

III. MHC'S PLACE IN INTERNATIONAL LAW

The end goal of the CCW meetings is not completely clear. One proposal is to draft a treaty that includes language that would only permit autonomous weapons operated under MHC. This could come in the form of an additional protocol that some states sign and ratify, or the CCW discussions could simply be a way to put international pressure on states to adopt their own rules which would incorporate MHC, such as the US DoD Directive 3000.09, discussed further below. If MHC language is included in any national rules, it will eventually have to be interpreted. Another direction that meetings could take is toward an understanding among most states that international law already requires MHC, and the concept could become customary international law. Regardless of where the endpoint is, a useful starting point is to understand the positions that states have held at the CCW meetings.

a. State Reactions to MHC at CCW meetings

At the CCW Convention in May 2014, there was a "widely shared" view that it is important to maintain MHC for decisions of life and death.[34] Most states expressed the desire for continued discussion in an area of complex, developing technology, and the view that the CCW was the appropriate forum for doing so. Some states even took firm positions on MHC, with Austria holding that weapons without MHC were already in contravention to International Humanitarian Law ("IHL").[35] At the April 2015 meeting, Austria clarified that MHC "should not be seen as a new legal norm, but as evaluating LAWS on the basis of existing standards of international humanitarian law."[36] In 2014, India did not take a position of accepting or rejecting the concept of MHC.[37] Pakistan did not agree with the concept of MHC because it is too vague, but only because the state held the position that there needs to be clear language

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[34] Michael Biontino, Germany Delegation Closing Statement to 2014 CCW Meeting of Experts on Lethal Autonomous Weapons Systems, (May 16, 2014) (transcript available at http://www.unog.ch/80256EE600585943/(httpPages)/A038DEA1DA906F9DC1257DD90042E261?OpenDocument) [hereinafter "UN CCW 2014 LAWS meeting webpage"].

[35] Austrian Delegation Closing Statement to 2014 CCW Meeting of Experts on Lethal Autonomous Weapons Systems, (May 16, 2014) (transcript available at UN CCW 2014 LAWS meeting webpage).

[36] Austrian Delegation to Informal Meeting of Experts on Lethal Autonomous Weapons Systems (LAWS), *The Concept Of "Meaningful Human Control,"* (United Nations Office at Geneva, 2015), *available at* http://www.unog.ch/80256EE600585943/(httpPages)/6CE049BE22EC75A2C1257C8D00513E26?OpenDocument.

[37] Indian Delegation Closing Statement to 2014 CCW Meeting of Experts on Lethal Autonomous Weapons Systems, (May 16, 2014) (audio recording available at UN CCW 2014 LAWS meeting webpage).

that creates a complete ban on AWS through an additional protocol to the CCW.[38]

The United States' position at the CCW Convention in April 2014 was that MHC, "does not sufficiently capture the full range of human activity that takes place in weapon system development, acquisition, fielding and use; including a particular commander's or an operator's judgment to employ a particular weapon to achieve a particular effect on a particular battlefield."[39] Even though the understanding of MHC at the meeting was still developing, the United States held the minority position at the Convention, that MHC is not appropriate language for a treaty. States held a wide variety of views on what MHC could imply and whether or not it is even useful as a legal tool for regulation, but all did agree that discussion should continue.

b. International Law Already Regulating AWS

Before delving deeper into what may be required for state compliance with MHC, it will be useful to consider which fields of law already govern the use of AWS. While MHC was debated at the CCW as a way to regulate the use of AWS, that does not mean there is currently no legal structure in place. There are already treaties and customary international law with which states have obligations to comply.

The applicable international law in situations of armed conflict is referred to as IHL.[40] One important IHL consideration that has been codified by treaty is Article 36 of Additional Protocol I to the Geneva Convention, which creates a rule for the legal review of new weapons developed by a state. It provides that,

> In the study, development, acquisition or adoption of a new weapon, means or method of war, a High Contracting Party is under an obligation to determine whether its employment would, in some or all circumstances, be prohibited by this Protocol or by any

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[38] Pakistan Delegation Closing Statement to 2014 CCW Meeting of Experts on Lethal Autonomous Weapons Systems, (May 16, 2014) (audio recording available at UN CCW 2014 LAWS meeting webpage).

[39] United States Delegation Closing Statement to 2014 CCW Meeting of Experts on Lethal Autonomous Weapons Systems, (May 16, 2014) (audio recording available at UN CCW 2014 LAWS meeting webpage).

[40] *See generally* INT'L COMM. OF THE RED CROSS, WHAT IS INTERNATIONAL HUMANITARIAN LAW? (2004) *available at* https://www.icrc.org/eng/assets/files/other/what_is_ihl.pdf.

> other rule or international law applicable to the High Contracting Party.[41]

The requirements set by Article 36 mean that a state has an obligation to review its new weapons to make sure that the weapons comply with international law, and in the case of AWS, the applicable international law would primarily be IHL. While this is an important constraint upon states in the regulation of new weapons, it only imposes regulation of currently existing laws.

Despite the lofty goals of Article 36, under the provision, states can decide for themselves how they will analyze the expected use of a weapon.[42] Moreover, because of the secret nature of the weapons reviewed, it is not likely that the review process would be made public.[43] These limitations to the Article 36 review process impede the process from having real significance. At the same time, the United States is a not a party to Additional Protocol I, but it does have its own review mechanisms that require it to ensure that any weapons developed are consistent with applicable treaties and customary international law.[44]

On the other hand, at the April 2015 CCW meeting, William Boothby argued that under the current state of technology, most offensive AWS will not be able to comply with the targeting requirements of the weapons review that is currently required by international law, demonstrating that the current IHL structure can regulate AWS in some form. He went on to say that instead of a ban on AWS, there should be a greater emphasis on enforcing the already existing weapons review process.[45] He suggests that in the future, the Article 36 review process could be more useful because it will be a method that allows international law to be complied with more reliably.

Even though Article 36 may not currently have a true ability to regulate weapon development, IHL nonetheless governs weapon development and implementation. IHL incorporates the important

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[41] Protocol Additional to the Geneva Conventions of 12 August 1949, and relating to the Protection of Victims of International Armed Conflicts (Protocol I), art. 36, June 8, 1977 1125 U.N.T.S. 3 [hereinafter AP I].

[42] CLAUDE PILLOUD ET AL., COMMENTARY ON THE ADDITIONAL PROTOCOLS OF 8 JUNE 1977 TO THE GENEVA CONVENTIONS OF 12 AUGUST 1949 424 (Yves Sandoz et al. eds., 1987).

[43] WILLIAM H. BOOTHBY, WEAPONS AND THE LAW OF ARMED CONFLICT 343 (2009).

[44] U.S. DEP'T OF DEF., DIRECTIVE 5000.01: THE DEFENSE ACQUISITION SYSTEM, 7 (2007).

[45] William H. Boothby, Presentation to the 2015 CCW Meeting of Experts on Lethal Autonomous Weapons Systems (April 2015) (text available at http://www.unog.ch/80256EE600585943/(httpPages)/6CE049BE22EC75A2C1257C8D00513E26?OpenDocument) [hereinafter "UN CCW 2015 LAWS meeting webpage"].

principles of distinction and proportionality, with distinction being rooted in the idea that any individual that is not a combatant is a civilian and proportionality being rooted in the idea of balancing military advantage *ex ante* against civilian casualties. Consequently, states must ensure that any future AWS meet the requirements of distinction and proportionality in its targeting capabilities.

The principle of distinction is derived from Additional Protocol I of the Geneva Convention which says that "Parties to [. . .] conflict shall at all times distinguish between the civilian population and combatants and between civilian objects and military objectives and accordingly shall direct their operations only against military objectives."[46] The principle of distinction specifically becomes difficult because it means that an AWS must be able to receive data, and based on that information, decide for itself whether or not the target is a combatant or a civilian. This may be possible for a computer program to distinguish between a combatant and a non-combatant with targets such as tanks or large military installations, but it becomes more difficult when the AWS must distinguish a combatant from a civilian.[47] Consider the situation of a civilian that may be wearing camouflage clothing simply for fashion, and the necessity of a machine that can discern that the person is not a combatant based on clothing. This is a simple example, but demonstrates the type of programing necessary for AWS to perform a lawful act. Proponents of a ban on AWS cite this technological obstacle as a reason for illegality. On the other hand, some scholars argue that AWS technology should not be approached from a *per se* illegal viewpoint, but rather looked at with more legal scrutiny on an individual case by case basis as to whether there is compliance with IHL.[48] This argument is more convincing because of the wide range of technology that AWS can encompass. Additionally, some scholars argue that distinction may also be an easy requirement for AWS to satisfy, because there may be certain scenarios where there are no civilians present.[49] It may or may not be the case that in the majority of factual situations an AWS cannot be programmed to comply with IHL, but that does not necessarily mean that an AWS in a low-clutter, low-civilian situation could *not* comply with IHL.

In compliance with IHL, proportionality can be even more difficult to implement than distinction because it involves an analysis of the legality of an armed attack by weighing the tactical military advantage

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46 AP I, *supra* note 41, at art. 48.

47 Wagner, *supra* note 13 at, 1391-1392.

48 *Id.* at 1423-1424.

49 Jeffrey S. Thurnher, *The Law that Applies to Autonomous Weapon Systems*, 17 AM. SOC'Y OF INT'L LAW INSIGHTS (Jan. 18, 2013).

against injury to civilians. As a principle, proportionality has also been reflected in Additional Protocol I of the Geneva Convention. It considers an attack to be indiscriminate which "may be expected to cause incidental loss of civilian life, injury to civilians, damage to civilian objects, or a combination thereof, which would be excessive in relation to the concrete and direct military advantage anticipated."[50] This can involve an infinite number of factors that vary greatly by situation. This means that AWS must be able to interpret and weigh all the factors that could go into civilian loss of life in an attack. Neither the factors of "military advantage" or "civilian losses" are easy to quantify, and therefore are difficult to balance against one another—a task as difficult for a human as much as it would be to program for a machine. [51] In addition to the balancing factors being difficult to quantify, the factors or "military advantage" and "civilian losses" are also dissimilar, making whatever proportionality found dissimilar as well.[52] As noted above with the principle of distinction, some scholars would argue that proportionality may also be more easily achieved with AWS in environments with few civilians.[53] All of these technological obstacles create legal challenges for AWS, but as noted above with the principle of distinction, the obstacles may not necessarily mean that compliance with IHL is never possible. Compliance may only be a matter of technological development.

The international legal regimes already mentioned have the greatest impact on AWS, but there are others still that can have an impact such as international human rights law, law of the sea, space law, and others.[54] While all of these areas may impose constraints on AWS, an explanation of the field of each area of law is beyond the scope of this paper. From what was outlined above, it is imperative to consider that the current legal framework of IHL may already be adequate for the regulation of AWS. The rest of this paper will continue to explore an understanding of MHC and the requirements it may add to the current legal system in an attempt to regulate AWS, but that does not mean that IHL as it stands now would not be sufficient for the purpose of regulation.

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[50] AP I, *supra* note 41, at art. 52(5)(b).

[51] *Supra* note 13 at, 1393-1395.

[52] William J. Fenrick, *The Rule of Proportionality and Protocol I in Conventional Warfare*, 98 MIL. L. REV. 91, 102 (1982).

[53] Kenneth Anderson et al., *Adapting the Law of Armed Conflict to Autonomous Weapon Systems*, 90 INT'L L. STUD. 386, 403 (2014).

[54] *See generally* Rebecca Crootof *The Varied Law of Autonomous Weapon Systems*, NATO ALLIED COMMAND TRANSFORMATION, AUTONOMOUS SYSTEMS: ISSUES FOR DEFENCE POLICY MAKERS (forthcoming 2016) *available at* http://ssrn.com/abstract=2569322.

c. Example of US DoD Directive 3000.09

For the purpose of regulating its internal development of autonomous weapon systems, the DoD has issued Directive 3000.09 ("Directive").[55] The Directive provides an example of what implementation of MHC could look like at the national level. Despite the United States' opposition to MHC at the CCW, the Directive uses similar language and says that "[a]utonomous and semi-autonomous weapon systems shall be designed to allow commanders and operators to exercise appropriate levels of human judgment over the use of force."[56] Just as MHC is a term searching for a greater understanding, the DoD also has not defined "appropriate levels of human judgment." Though, in the glossary of the Directive, a "human supervised autonomous weapon" has been defined as "[a]n autonomous weapon system that is designed to provide human operators with the ability to intervene and terminate engagements, including in the event of a weapon system failure, before unacceptable levels of damage occur."[57] This additional definition sheds some light on what it would mean for a human to supervise, but it still does not explain what the "appropriate levels" are or how there might be MHC.

The Directive as a whole struggles with the problem of MHC in not defining how much control is necessary by a human. "Appropriate levels of human judgment" does not provide any guidance as to where a human must be involved in the OODA Loop, just as it does not give guidance as to what level of human control must be reached on Sharkey's Levels of Control, two concepts that will be explained in detail below. So, while the United States has adopted similar regulatory language to that of MHC, it does not appear that it was particularly guiding in creating effective legal protection or regulation of AWS, at least in terms of clarity. As shown at the CCW meeting in 2014, even though the MHC seems to have similar language as the Directive, not all states interpreted that language to mean the same thing.

IV. UNDERSTANDING THE IMPLEMENTATION OF MHC

After understanding where MHC may fit within the broader scope of international law, this section will consider what the concrete effects of MHC may actually be. If the treaty language is adopted, states will have to take a position on an interpretation that allows them to move forward with the development of technology in compliance with international

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55 *Supra* note 9 at 1(a).
56 *Id.* at 4(a).
57 *Id.* at 14, Glossary.

obligations. The following section will explore factors that states will have to consider when looking to understand the implications of MHC, particularly with a greater emphasis on the "human control" aspect of MHC.

a. Understanding MHC Through Human Placement "in," "on," or "out of the loop"

One place to begin analyzing MHC is *where* in the decision-making process humans are involved. One tool to understand "the where" in the decision-making processes of humans is the OODA Loop, a concept created by military strategist John Boyd.[58] The acronym stands for (1) Observe, (2) Orient, (3) Decide, and (4) Act.[59] It is a tool for understanding the process along which a human can receive information, analyze that information to make a decision, and then act upon it. Orientation is the most important because it shapes the way the person observes, decides, and acts based on his or her past experiences.[60] Boyd successfully applied it to military strategy by using it to learn how to speed up the decision-making process and at the same time disorient the enemies' decision-making process, creating a tactical advantage on the battlefield.[61]

The OODA Loop was originally developed for use by humans, but can be applied in the field of AWS because of its related nature and prevalent use in the military to understand the decision making process. The description above of the OODA Loop is a simplification of the theory developed by Boyd of what takes place in implementing an action, but it provides a basic framework to help with a legal analysis of MHC. Three ways of conceptualizing the involvement of humans with weapon systems, and consequently whether there may be MHC, is whether humans are "in the loop," "on the loop," or "out of the loop."

It is hard to imagine that any interpretation of MHC would have humans "out of the loop," which could be understood as a human ordering an AWS on a mission assignment and then having no further involvement. So, an important consideration for MHC will be where "in the loop" or "on the loop" humans need to be involved. Assuming it were technologically possible for an AWS to be assigned a mission with an act to destroy a target where there was no human control at any level, then

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[58] For a discussion of John Boyd's development of the OODA Loop *see* ROBERT CORAM, BOYD: THE FIGHTER PILOT WHO CHANGED THE ART OF WAR (2004).

[59] *Id.* at 334-339.

[60] GRANT T. HAMMOND, THE MIND OF WAR: JOHN BOYD AND AMERICAN SECURITY 165 (2004).

[61] *Supra* note 58, at 339.

where could a human be added "in the loop" or "on the loop" to create MHC? The decision stage of the OODA Loop will be the most difficult for a machine to autonomously perform and the performance will depend on how it has been programmed.[62] Because the decision stage is the most difficult to program, would that make that stage the most meaningful for human involvement? Given the current technology as described above, it is at the decision stage that a machine will most likely still need input from a human operator on how to proceed once it has observed and oriented itself with its surroundings because this stage will require the compliance with the international principles of proportionality and distinction. However, if in the future a machine were able to make its own decision, but action included human authorization, would this be sufficient to create MHC? Worth noting, orientation is the most important stage of the OODA Loop because orientation can include a person's repository of genetic history and cultural heritage, which will be much more difficult to replicate with a machine.[63] Under the same scenario, could including a human at the orientation stage provide MHC?

Many of these questions do not have one simple answer. The OODA Loop is a very simple way to consider the complex machine and human decision-making processes, and may even be too simple for legal analysis, but it helps give an understanding of what it may mean for a human to be "in" or "out of the loop." However, even though the OODA Loop helps to classify where a human is "in the loop," MHC as a concept does not become any clearer. There are so many varied situations for the amount of control that a human can have over a machine that the adoption of MHC treaty language would not help clarify where "in the loop" a human must be positioned.

b. Levels of human involvement

A different way to analyze or characterize MHC is through how much humans are involved in the decision-making process. In an attempt to explain a different dimension of control, Noel Sharkey developed a way to classify levels of control. Sharkey's system quantifies control by assigning it a number along a scale, but in some ways, it still is simply looking at where "in" or "on the loop" a human can be placed to create appropriate MHC. Where the OODA Loop is a tool that can help describe where a human is involved in the decision process, Sharkey's Levels of Control explain how much a human is involved in the decision process. His levels are as follows:

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[62] William C. Marra & Sonia K. McNeil, *Understanding the Loop: Regulating the Next Generation of War Machines*, 36 HARV. J.L. & PUB. POL'Y 1139, 1148 (2012).

[63] *Supra* note 59.

> 1. Human deliberates about a target before initiating any attack.
>
> 2. Program provides a list of targets and human chooses which to attack.
>
> 3. Program selects target and human must approve before attack.
>
> 4. Program selects target and human has restricted time to veto.
>
> 5. Program selects target and initiates attack without human involvement.[64]

In his development of these levels, he has determined that levels one and two would be acceptable levels of human control, while levels three, four, and five would not. Sharkey argues that level three is unacceptable because of automation bias, and levels four and five are not acceptable because there is not a human "in the loop."

Levels one and two can both be easily considered to have humans "in the loop." Level three begins to limit *how much* a human is involved "in the loop," which is why Sharkey objects. More so, Level 4 would not even have a human "in the loop," but rather only "on the loop," which is to say that a human would be overseeing the decisions being made by AWS. This is the direction that the U.S. Air Force sees its operations and capabilities heading within the next 40 years, where humans will only "monitor the execution of certain decisions."[65]

It is questionable whether any military activity such as the goals of the U.S. Air Force in achieving "on the loop" capabilities would comply with any requirements of MHC. While it may be possible to say that a human is involved in the control of AWS by overseeing the decisions it makes, would this really be meaningful if there are hundreds or even thousands of decisions that must be monitored by one human? Also, if a decision is so important that a human must oversee it, then why does a human not make the decision to begin with? While there are going to be efficiency gains in using AWS technology, if compliance with MHC requires meaningful human supervision, then the efficiency gains made

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[64] Noel Sharkey, *Towards a Principle for the Human Supervisory Control of Robot Weapons*, 2 POLITICA & SOCIETÀ, 305-324 (May-Aug. 2014) (It.).

[65] United States Air Force, UNMANNED AIRCRAFT SYSTEMS FLIGHT PLAN 2009–2047 41 (2009), *available at* http://www.fas.org/irp/program/collect/uas_2009.pdf.

by autonomy may be lost in exchange for a lack of human decision making over questions of life and death.[66]

As a separate way of framing the human involvement, Mark Roorda asks those debating the legality of AWS to consider the approach taken by NATO in its targeting and engagement process.[67] Roorda proposes that it is the human process of planning, targeting, and the legal analysis *before* the launch of an AWS that allows compliance with IHL.[68] The "launch" point would be the time at which the AWS is operating on its own and will engage targets with no further human involvement.[69] The AWS is not operating completely independent of humans because it must still rely on the programing and planning that was done before the launch point. This way of looking at human involvement is not so much that a human will be "out of the loop," but rather that a human will have significant enough involvement before the launch to be in compliance with IHL. It is possible that this is an approach states could take with weapons systems, but it also raises the question of whether or not this is still autonomy. What is described fits under the DoD definition, and would depend on whether the weapon could "select and engage" on its own following the launch point of human involvement.[70]

The examples given by the U.S. Air Force and NATO represent the varied forms of what it may look like to have human control. It is not a simple "yes or no" question of whether human control exists. And even if Sharkey's levels of control can help to answer some of the questions about where "on" or "in the loop" a human must be placed to create the "human control" of MHC, it still does not answer all the questions about what may actually be *meaningful* control by a human. This would suggest that MHC would be just as difficult to interpret if it were adopted as language into a treaty.

c. Does MHC imply a ban on AWS?

Because of the fear of the possible indiscriminate nature of autonomous weaponry, several actors in the discussion of AWS have

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66 *See* Markus Wagner, *The Second Largest Military: Private Military Contractors & State Responsibility,* (Univ. of Miami Legal Stud. Res. Paper No. 2010-10), *available at* http://ssrn.com/abstract=1588240 (discussing how private military contractors may be cost prohibitive if the necessary oversight mechanisms were put in place to ensure compliance with IHL).

67 Mark Roorda, *NATO's Targeting Process: Ensuring Human Control Over and Lawful Use of 'Autonomous' Weapons* 4 (Amersterdam L. Sch. Legal Stud. Res. Paper No. 2015-13).

68 *Id.* at pg. 11.

69 *Id.* at pg. 16-17.

70 *Supra* note 9.

called for a complete ban.[71] Because MHC is still open for interpretation, it is also still open for consideration as to whether MHC requires a ban on AWS. Regardless, this still leaves the same issues discussed above regarding levels of autonomy and the lack of a definition of autonomy unresolved. Would a ban include only certain thresholds of autonomy?

In his report to the United Nations Human Rights Council, Special Rapporteur Christof Heyns recommended the Council to call on all states to implement a moratorium "on at least the testing, production, assembly, transfer, acquisition, deployment and use of [lethal autonomous robots]."[72] Many NGOs such as Human Rights Watch and Article 36 have rallied behind this cause to form the Campaign to Stop Killer Robots, which adopts the same positions as those outlined in Heyns' Report.[73] The report justifies a comprehensive ban because it also calls for the formation of a panel to research and understand the developing technology, and then recommend policies for governing autonomous weaponry.[74]

One way the ban on AWS has been justified is by way of the Martens Clause.[75] At the 2015 CCW meeting in Geneva, the state of Chile held the position that the Clause should necessarily be applied to emerging technology.[76] The Martens Clause requires that for issues not covered by regulations, international humanitarian law will apply, "as they result from the usages established among civilized peoples, from the laws of humanity, and the dictates of the public conscience."[77] So, the argument is made that weapons without MHC operate in violation of the laws of humanity and even arrive to the point of being morally unacceptable.[78] The "dictates of the public conscience" becomes a valid

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[71] *See The Solution,* CAMPAIGN TO STOP KILLER ROBOTS, (Mar. 30, 2015) http://www.stopkillerrobots.org/the-solution/.

[72] Christof Heyns. Report of the Special Rapporteur on Extrajudicial, summary or arbitrary executions. A/HRC/23/47. 9 Apr. 2013 at ¶113 (Heyns uses the term LAR for lethal autonomous robots, but defines it in the same way as AWS in DoD 3000.09).

[73] *Supra* note 71.

[74] *Supra* note 72, at ¶ 114.

[75] Denise Garcia, *The Case Against Killer Robots*, FOREIGN AFFAIRS, May 10, 2014 (Feb. 28, 2015) http://www.foreignaffairs.com/articles/141407/denise-garcia/the-case-against-killer-robots.

[76] Chile, a paper on "LAWS, Human Rights and Ethics." 15 April 2015. UN CCW 2015 LAWS meeting webpage.

[77] Preamble, 1907 Hague Convention (IV) respecting the laws and customs of war on land, reprinted in A. Roberts and R. Guelf, *Documents on the Laws of War*, 3rd ed., Clarendon Press, Oxford, 2000, p. 69.

[78] *Substantive Talks on Killer Robots Must Continue: Convention on Conventional Weapons decision due on 14 November,* FACING FINANCE (Nov. 18, 2014), http://www.facing-finance.org/en/2014/11/substantive-talks-on-killer-robots-must-continue-convention-on-conventional-weapons-decision-due-on-14-november-2/

source for the creation of new IHL under the Martens Clause. This however, is extremely difficult to interpret, because it requires an interpretation of what the "public conscience" may be, possibly relying on public opinion, empirical social science analysis, and some way to synthesize those findings into concrete law.[79] While the Martens Clause does provide one argument for the implementation of a ban on AWS, a ban should not be sought as an answer to the questions arising in the developing field of AWS.[80]

Opponents of a ban argue that the reasons for a complete moratorium rest on a weak foundation. First, any arguments that the technological capabilities of AWS could never comply with IHL are arguments that would rest on assumptions that certain levels of technology are unattainable.[81] There is no way of knowing what sort of technological developments the future may hold. Second, there is a shaky foundation for the moral argument of not allowing machines to make targeting decisions of life and death. More and more of daily life has been delegated to machines, such as the operations of factories or the ability of cars to drive themselves, representing a societal choice to delegate these responsibilities.[82] It is possible that if a the public conscience views killing as acceptable when the decision is made by another human, then the public conscience may also be content with a decision to kill delegated to an autonomous system.

Boothby argues that a ban would be "ill-advised" because the current Article 36 review process is sufficient to regulate AWS if the process is enforced.[83] One of the foundations that this argument rests on is his understanding that MHC should not "be elevated into some sort of legal criterion that determines the acceptability of a weapon system."[84] He believes that it may be useful to address technology as it is now, but it is not appropriate as a long-term solution.[85]

These arguments, among others, made by opponents of a ban seem to generally show that a complete ban would be too sweeping, extreme, and unnecessary for effective regulation. A ban on AWS would be a detriment to technological development in the area of weapon

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79 Peter M. Asaro, *Jus nascendi, robotic weapons and the Martens Clause, in* ROBOT LAW 367, 371-375 (Ryan Calo et al. eds. 2016).

80 Tyler D. Evans, *At War with the Robots: Autonomous Weapons Systems and the Martens Clause,* 14 HOFSTRA L. REV. 697, 732-33 (2013).

81 Kenneth Anderson & Matthew C. Waxman, *Law and Ethics for Autonomous Weapon Systems: Why a Ban Won't Work and Why the Laws of War Can* (AM. UNIV. WASHINGTON C.OF L. RES. PAPER No 2013-11).

82 *Id.* at 15-16.

83 *Supra* note 43, at 3.

84 *Id.*

85 *Id.*

technology, which would also stifle the development of rules and regulations to accompany that development. While a ban may seem attractive because it is a simple answer, it would not be helpful in understanding or creating concrete laws to regulate AWS.

d. Does IHL Require Compliance with MHC?

As already mentioned above, some states and civil society groups hold the position that IHL *already* requires that weapons be subject to MHC, which as also described above incorporates the principles of distinction and proportionality.[86] Most scholars agree that distinction and proportionality must govern AWS in general under IHL. But taking it a step further, proponents of IHL already incorporating MHC hold that because the principles of distinction and proportionality prohibit the use of weapons that target and shoot indiscriminately, the lack of a human in AWS constitutes indiscriminate target selection, therefore prohibiting any autonomous target selection and firing.[87] Proponents of the ban are not only worried that the current technology does not allow AWS to comply with distinction and proportionality, but also that technology will never reach a point where it can comply with the principles when there is not a human involved.[88]

On the other hand, Crootoff holds that AWS do not necessarily violate the principles of distinction and proportionality by their autonomous capabilities, but proposes they can be used in discriminate and proportionate ways.[89] She holds the position that autonomous weapons are already in use with little critique, demonstrating that compliance with IHL is already a possibility for AWS.[90] Compliance for AWS is achieved the same way that proportionality is achieved for a given situation: through an analysis of specific facts and the specific context. This is important to consider because this idea is in direct contradiction with a ban on AWS as a whole, and it raises the question of whether a ban on AWS would be ignoring some of the capabilities of AWS. Proponents of a ban also propose a panel that would develop laws to regulate AWS in the future, but this would not be necessary when the current system of IHL sufficiently governs AWS.[91] As mentioned above,

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86 *Supra* note 35.

87 *Supra* note 64.

88 HUM. RIGHTS WATCH and INT'L HUM. RIGHTS CLINIC, ADVANCING THE DEBATE ON KILLER ROBOTS: 12 KEY ARGUMENTS FOR A PREEMPTIVE BAN ON AWS (2014).

89 Rebecca Crootof, *The Killer Robots are here: Legal and Policy Implications*, 36 CARDOZO LAW REV. 1837, 1874 (2015).

90 *Id.* at 1884

91 *Supra* note 72 at ¶ 114.

compliance with IHL could be enforced through the Article 36 review process.

If a significant number of states were ultimately to agree that MHC were a part of IHL it could eventually become customary international law without ever going through the process of being codified in a treaty. But, as is usually the trouble with most international law adopted in this form, those that oppose it would probably continue to oppose it and claim immunity to its application through the theory of the persistent objector. If MHC were to be adopted as language in a treaty, it would show a greater acceptance by the international community for a standard in an area of new technology, even if that standard may not be particularly clear or useful.

IHL should not be understood to already incorporate MHC. As this paper has noted above and will continue to explain below, MHC is not a useful term because there are too many interpretations that will not be effective for the regulation of AWS. The current IHL framework already has the principles of distinction and proportionality to govern AWS, and if it is determined that AWS cannot comply with these principles it would be an illegal weapon. It is not necessary to muddy the legal waters with the incorporation of MHC into IHL.

The concept of MHC does not appear to be able to offer a solution to the technical, legal, moral and regulatory questions of AWS. It may appear that the term MHC offers a sort of "jumping-off point" for discussing what is appropriate for human involvement in weapon systems, but it does not offer any clear answer to questions of how human involvement is needed or what level of human involvement is needed. The discussion generated around MHC has shown that some form of regulation is needed, but MHC does not work to address those concerns, and potential regulation may already have a framework under current IHL. The concept of MHC leaves too much room open for interpretation and does not give enough guidance on what is and is not permissible. While the view that MHC is a clear enough concept, meant to be fluid for future technology is admirable, it is not clear enough to be reliable for the process of developing new technology.[92]

V. HOW MEANINGFUL IS MHC?

The previous section of this paper discussed the legal barriers and complications to MHC in international law. Where the previous part of

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[92] *Contra* UNITED NATIONS INST. FOR DISARMAMENT RESEARCH, THE WEAPONIZATION OF INCREASINGLY AUTONOMOUS TECHNOLOGIES: CONSIDERING HOW MEANINGFUL HUMAN CONTROL MIGHT MOVE THE DISCUSSION FORWARD 4 (2014).

the paper looked at some of the "big picture" concepts that structure the overall framework of MHC within international law along with the "human control" of MHC, this part will consider some of the factors of what "meaningful" actually means within MHC. This will be done by considering some of the factors that influence the interaction of humans and weapons systems with which they interact—factors that should be used in considering whether MHC is useful as regulatory treaty language. One of the first factors that can be considered is automation bias.

a. Automation bias

When machines aid humans in making decisions, it is possible that the operator can follow the advice of the machine, even though it may be wrong. This is a commission error form of automation bias where the operator incorrectly relies on the information given by the automated machine.[93] Automation bias is premised on the idea that when an operator has contradictory information from different sources, the operator will put a greater degree of trust in the computer-generated information than in other sources, which may or may not be more reliable.[94] In studies that were done on automation bias, results showed that informing participants about the possibility of automation bias did not significantly reduce its effect.[95] That is to say that the results of the studies support the idea that automation bias is not avoidable simply by telling a human operator to act without bias. This is not just an abstract concept studied in laboratories, but has real life examples.

On July 3, 1988, the *USS Vincennes* launched two missiles at the civilian Iran Airline Flight 655 bound from Bandar Abbas, Iran to Dubai, UAE. None of the 290 persons onboard the Airbus A-300 survived the missile strike.[96] This attack was unintentional, and some of the primary reasons given by the United States Government for the accident were the escalating tensions between the two governments, an increase in Iranian military aircraft to the Bandar Abbas airport, and a short amount of time to a make a decision by the U.S. commander, among other factors.[97] One of these escalations was an unsuccessful Iranian attack on a Danish ship

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[93] J.E. Bahner et al., *Misuse Of Automated Decision Aids: Complacency, Automation Bias, And The Impact Of Training Experience*, 66 INT'L. J. HUMAN-COMPUTER STUD. 688, 689 (2008).

[94] *Id.* at 689.

[95] *Id.* at 696.

[96] Lt. Col. David Evans, *Vincennes: A Case Study,* PROCEEDINGS MAG. (Aug. 1993), available at http://www.usni.org/magazines/proceedings/1993-08/vincennes-case-study.

[97] Dep't of Def., Formal Investigation Into the Circumstances Surrounding the Downing of Iran Air Flight 655 on July 3, 1988, 61-63.

just one day before the *USS Vincennes* incident. In that attack, the Danish ship requested assistance from the *USS Montgomery*, which observed small Iranian boats firing rockets at the Danish ship. After the *Montgomery* fired a warning shot, the small boats retired.[98] In addition to the events from the previous day, other contributing factors to the *USS Vincennes* incident were psychological factors such as stress, task fixation, and an "unconscious distortion of data [which] may have played a major role in [the] incident."[99] During the event, officers received incorrect information from an automated machine that a military aircraft was flying in their direction, and it appears that they made all other available evidence fit the scenario that was received from the machine, ultimately leading to a missile firing on an incorrectly identified civilian aircraft. This incident is an early example of what may have been automation bias leading to the accidental downing of a civilian aircraft.

This automation bias manifested itself in what was labeled in the official U.S. DoD report as "scenario fulfillment." The opinions given in the report describe how the officers involved in the incident "appear to have distorted data flow in an unconscious attempt to make available evidence fit a preconceived scenario."[100] The humans that were "in the loop" of this automated decision process had a bias toward the information they received that was automated. That bias created a scenario that they continued to fulfill in their minds, which ultimately led to the misunderstanding that caused the downing of the civilian aircraft. This is a situation of a human "in the loop" because the automated information of a military airplane flying overhead was given to a human that then authorized the launching of a missile.

Automation bias is important to consider in MHC because even when a human may have a supervisory role or a minor "in the loop" role with an automated machine, it raises the question of whether this role is actually meaningful. It may be that with some automated systems, a human can be "in the loop" to a certain degree and meaningful control is more easily achieved than with a different automated system. Will MHC be a rule that can be easily applied in cases of different types of AWS? It may be the case that the rule is flexible enough for different types of AWS and can be applied to future AWS as well, but this is only because MHC is a vague enough concept that it can be interpreted broadly. Complex factors such as automation bias and scenario fulfillment, which may play out different by the facts of situation, question the usefulness of such a concept as MHC.

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98 *Id.* at 16-17.
99 *Id.* at 63.
100 *Id.*

b. Automation-induced complacency

In addition to automation bias, a related concept is automation complacency. This is the idea that under heightened work conditions, an operator of an automated system will not notice malfunctions or will fail to correct errors by the automation because of the busyness of focusing on other manual tasks.[101] Continued research seems to support this concept of automation-induced complacency, even though participants in studies seemed to deny the conclusions that any sort of automation complacency existed when self-assessed.[102] These scientific findings may still require further research, and more theories will likely continue to develop as does technology. But, they present considerations of why the law needs to consider what MHC really means. Is a human's control meaningful if it becomes complacent?

As a correction to human complacency, Parasuramnan has proposed adaptive automation.[103] This is the idea that when a human operator is at a greater stress level and must manually operate more controls, the automated machine will be programmed to operate at a greater degree of automation.[104] However, when the operator is at a lower level of stress, the automated machine will be programmed to operate at lower degree of automation so as to avoid such complacency.[105] This is a way of keeping the operator more engaged when she is in periods of less stress and has more time to engage in operation.

A problem with adaptive automation is that it points directly to the issue that a greater degree of human involvement may be necessary in situations of high stress. If an operator of a machine will fail to notice an error that comes from automated systems when she is in high stress situations, then could it simply mean that another operator is needed? Automation complacency is not a factor that would be assisted much by the adoption of MHC. It is not clear whether automation complacency is a strong enough problem that would mean MHC is not established in the operation of a machine, and it would also not be clear if solutions such as adaptive automation would establish MHC.

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[101] Raja Parasuramna & P.A. Hancock, *Mitigating the Adverse Effects of Workload, Stress, and Fatigue with Adaptive Automation, in* PERFORMANCE UNDER STRESS 45, 49 (Peter A. Hancock, ed. et al., 2008).

[102] NASRINE BAGHERI & GREG A. HAMIESON, CONSIDERING SUBJECTICE TRUST AND MONITORING BEHAVIOR IN ASSESSING AUTOMATION-INDUCED 'COMPLACENCY' (2004).

[103] *Supra* note 101, at 46.

[104] *Id.*

[105] *Id.*

c. Automation Bias and Complacency in Other Fields

Automation bias and automation complacency are not something that exist solely in the field of weapons technology. One example of automation bias in another field is in the area of healthcare through clinical decision support systems (CDSS). The CDSS are automated systems that aim to provide physicians and their assistants information on a patient through alerts, reminders, diagnostic assistance, and therapy planning and critiquing.[106] Goddard, looks at research that has been done in the medical field on CDDS and compares it with other areas where automated technology is used to conclude that more research needs to be done to know whether automation bias is a result of overreliance on technology.[107] The research relied on shows that in twelve percent of the cases a physician would drop his incorrect diagnosis for a correct diagnosis from the CDDS, and in six percent of the cases the physician would drop his correct diagnosis for an incorrect diagnosis from the CDDS.[108] While this does show that there was a six percent net gain in diagnostic accuracy from the CDDS, it does also show evidence of what can be considered automation bias. This may be considered allowable or acceptable in diagnostics for certain medical issues, but will it be considered acceptable when the question arises for AWS?

Another more closely related field where studies have been done on automation complacency is in monitoring of air traffic. Studies showed that human monitoring of automated systems had a poor rate of detection of anomalies when the operators were engaged in other manual tasks.[109] An interesting finding of this study was that air traffic controllers were more likely to notice potential conflicts under active control conditions (human operated) than under passive monitoring conditions (automated).[110] And the time needed to correct a conflict under active controls as opposed to passive monitoring conditions during heavy traffic was significantly less, which could be critical during an emergency situation.[111]

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[106] Kate Goddard, Abdul Roudsari, & Jeremy Wyatt. *Decision Support and Automation Bias: Methodology and Preliminary Results of a Systematic Review*, 164 INT'L PERSP. IN HEALTH INFORMATICS 3 (2011).

[107] *Id.* at p. 7.

[108] Charles P. Friedman et al.,*Enhancement of Clinicians' Diagnostic Reasoning by Computer-Based Consultation*, 282 J. AM. MED. ASS'N 1851, 1854 (1999).

[109] Ulla Metzger & Raja Parasuraman. *The Role of the Air Traffic Controller in the Future Air Traffic Management: an Empirical Study of Active Control versus Passive Monitoring* 43 HUMAN FACTORS 519, 520 (2001).

[110] *Id.* at 526.

[111] *Id.*

Studies such as these in other fields may be useful for supporting the idea of keeping humans "in the loop" and may provide a useful comparison for the field of AWS and what it means to have MHC. However, these studies could also be interpreted as finding advantages to automated systems as well. Automation bias and complacency could be seen as factors that show a problem with human involvement. If computer systems had complete autonomy such as monitoring for their own diagnosis errors and air-traffic anomalies, could this reduce errors even more? The arguments of automation bias and complacency as a need for MHC may loose their strength if technology improves to the point of bringing automated and autonomous system errors close to zero.

Automation bias and automation complacency both show ways that MHC will be difficult to interpret. It is especially difficult to interpret the word "meaningful." This is because even when control is taken away from a machine and given to a human, there may be issues of a human still being biased or complacent if not enough control is given. It is possible that diplomats seek MHC as a way to account for automation bias and complacency, but the term is still too vague to give any guidance to states seeking to develop AWS that may be on the threshold of what it means to have MHC. There needs to be a way to guide states forward in what is permissible for developing technologies, but the MHC framework does not appear to be particularly useful in doing that.

VI. CONCLUSION

There is a need for international laws that regulate the development and use of AWS, but perhaps the system already in place for the regulation of weapons is adequate. Figuring out the best solution for regulation is particularly challenging when it is an area that is technologically new and continuing to develop.

While MHC may provide benefits from being simple in language, it fails to be useful for the same reasons. The proposed treaty language would not provide any significant guidance when it came to the development of weapon systems. It may be appealing in that MHC could be easily used as an argument for weapon systems that do not comply, but that looks at more prescriptive reasoning for a ban without allowing for any proscriptive rulemaking for states that will continue the development of AWS even if a ban were attempted at an international level.

The complexities of weapon systems can involve humans in a variety of different ways as was pointed out above with the distinction of "in the loop" and "on the loop." There are also the complexities of interpreting

how meaningful MHC must actually be because of problems such as automation bias and automation complacency. The language of MHC adopted in a treaty would not help to address these nuances and complexities of AWS.

The discussion continues regarding MHC, but the discussion should consider dropping the term altogether and look for a better approach to regulate AWS. The current framework of IHL, with its inclusion of the principles of distinction and proportionality, is likely already sufficient for the regulation of AWS. It does not appear that states will stop pursuing the development of AWS technology, but MHC does not appear to help states in any significant way to know whether they would be in compliance with international law. That is not say that there is some perfect formulation available that will create a bright line rule of what will make AWS acceptable when it comes to human involvement, but MHC does not appear to be the appropriate step forward for the international community.