Lethal Autonomous Weapon Systems: Translating Legal Jargon For Engineers

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Abstract— This article provides an overview of international law governing the use of autonomous weapon systems (AWS) in an armed conflict. Using the lens of autonomous systems, the article introduces basic international humanitarian law concepts, explains the legal framework behind what makes a weapon legal, and discusses the legal parameters surrounding employment of weapon systems. It also suggests a number of questions that engineers should ask attorneys during the design process in order to design autonomous systems that comply with the laws of armed conflict.

I. INTRODUCTION

An engineer, a commander, and a lawyer all met at the pearly gates of heaven. Their only entry requirement was that they be able to speak the same language regarding lethal autonomous weapon systems . . .

Query: How long did it take them to get through the gates?

While the above sounds like the beginning of a trite joke, the unfortunate aspect is that all too often lawyers' eyes glaze over as engineers begin speaking about reliability, control theory, and open architecture design while engineers tune-out at the mere mention of international law principles and go into a comatose state when the Latin phrases begin. With the growing utilization of robotics and autonomous systems on the battlefield, however, lawyers and engineers must learn to speak the same language . . . or at the very least, understand the basics of the other's world.

Why the imperative? Why can't engineers keep designing systems based on operator requirements and military lawyers just keep evaluating the legality of the weapons systems once the systems are built? The simple answer is that autonomy is different. Advances in autonomy have the potential to move the human warrior further and further out of the control loop and to leave more and more decisions up to the machine. The catch is that international law governing the laws of war were written to be implemented and thought through by people...not machines. Translating the legal requirements of use of force cannot be an after-thought in the development of autonomous weapon systems—it must be built-in from the beginning. The more engineers understand international law requirements and lawyers understand technical limitations of

autonomous systems the more likely we are to develop lethal autonomous weapon systems that comply with the law.

To further such understanding, this paper provides an overview of international law governing the use of autonomous weapon systems (AWS) in combat. While the question of "is it legal to fire this AWS?" appears to be a simple, straightforward question, the reality is much different. Multiple international legal regimes cover this question. The first section will provide an overview of the overarching bodies of law applicable to use of force. The second and third sections will then focus on the legal analysis that governs whether a weapon is both legal in the general sense (a concept called legal *per se* under international law) and in a particular context of a given target. Each section also provides questions that an engineer may seek to clarify with an attorney during the development of an autonomous weapon system.

II. ENGINEERS' GUIDE TO LEGAL JARGON: IHL, IHRL, *JUS AD BELLUM, JUS IN BELLO*

Today those concerned with the legal parameters of . . . the law of war in general, are presented with a confusing cacophony of treaties, declarations, agreements, and protocols, along with claims of binding international law that exists only as custom. The situation is further complicated by the fact that the preeminent airpower nation, the United States, is not a party to some of the leading international agreements that many (if not most) nations have acceded to. This can vastly complicate efforts to discern applicable legal norms.

- Charles J. Dunlap, Jr., Major General, USAF (ret.)
[1]

While at first blush the question of "can I use this autonomous weapon system to attack this target?" appears straightforward, the reality is that the answer requires review across multiple layers of international and domestic law. While many have likely heard of the Geneva Convention, it is not as well understood that the convention is comprised of four different treaties and three additional protocols that govern the treatment of war victims, civilians, prisoners of war, and the wounded. Making it more complex, the United States has not *ratified* or received Senate approval for all of these documents; yet the U.S. still follows many of the key provisions because it recognizes the rules as constituting *customary international law* that is binding on all countries irrespective of signature.

The analysis for whether it is legal to employ an autonomous weapon system starts with determining whether a *state* (what lawyers call a country) has the ability to attack another state in the first place, thereby violating its

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sovereignty. The law of sovereignty provides guidance about when one state can violate the territorial integrity of another state. [2] Relatedly, *jus ad bellum*, or “laws on war,” govern whether a state may resort to force. A state may employ force against or within another state if the United Nations Security Council has approved such action (e.g., Gulf War I) or if the state has consented to another state using force within it (e.g., to attack terrorist organizations). Another justification for use of force by a state is that of self-defense. Following the terrorist attacks of 9-11 and the increased use of UAV attacks by the United States on a number of countries, the scope of the self-defense doctrine has been debated heavily and remains controversial. [3] What is important to know from an autonomous weapons standpoint, is that the questions raised under this body of law have nothing to do with the type of weapon being used but instead about state authority to attack with any legal weaponry.

In addition to *jus ad bellum* laws regarding when a state can use force, international law also regulates the conduct of war itself. And yes, lawyers have more Latin for that area of the law—*jus in bello*. What is fascinating is that, regardless of whether a state has a legal right to violate another state’s sovereignty, states (or any militarized group) are still bound to follow the laws of war with respect to using force. [4] *Jus in bello* is also known as *international humanitarian law* (IHL). IHL norms apply whenever an *armed conflict* occurs either between states, between a state and an organized group, or between two or more organized groups. [5] International humanitarian law requires a certain level of intensity and duration (conflicts of a “protracted” nature) to rise to the level of an armed conflict vice a sporadic incident of violence. [6] The motivating rationale behind IHL is to separate civilians from legitimate military targets thereby keeping killing between *just* (vice unjust) belligerents. [7] IHL governs the force applied in warfare and holds those who apply that force accountable for reasonable action under these legal norms. [8] A more detailed discussion of IHL principles will occur in subsequent sections.

If no armed conflict is taking place, then *international human rights law* (IHRL) governs the legality of force. [9] Human rights law is based on the idea that every human being has certain rights to which he or she is entitled. IHRL covers a spectrum of issues from prohibition against slavery and torture to an individual’s right to equality before the law. Key governing documents of human rights law include the Universal Declaration of Human Rights and the International Covenant on Civil and Political Rights. [10] Some of the human rights principles include limitations on force. For example, IHRL recognizes each individual’s right to life and does not allow the targeting of an individual merely because of his or her status. [11] Under human rights law, the use of lethal force is only permissible to protect the life of oneself or others, and thus, is quite similar to the idea of self-defense in criminal law contexts. [12] In contrast, during armed conflict and under international humanitarian law, a soldier may shoot an enemy soldier simply because he or she is a member of the adversary’s forces or an *enemy combatant* and irrespective of whether the soldier is posing an actual threat at the time.

In sum, three separate bodies of international law govern the “simple” question of, “is it legal to fire this autonomous weapon?” Fortunately for the engineers’ sake, the first part of the analysis (*jus ad bellum*) has nothing to do with the type of weapon being used and everything to do with whether the state has a right to use force. Engineers do need to understand whether the weapon they develop has the possibility of being used outside of an *armed conflict*. If so, the autonomous weapon will require an ability to judge appropriateness of use of force under IHRL principles. Given that the United States generally employs weapons in situations arising under an armed conflict, the remainder of this paper will focus on legality of autonomous weapon systems and their employment under international humanitarian law.

Questions engineers should to ask lawyers about applicable international law:

- Will this autonomous weapon system ever need to engage a target outside of an armed conflict? If so, what type of distinctions will the system need to make based on human rights law in order to lawfully engage the target?
- Have any new treaties applicable to autonomous weapons occurred in the area of international humanitarian law (or *jus in bello*)? Has the United States signed and/or ratified them? If so, how should that law impact the design of an autonomous weapon system?
- Have any practices regarding autonomous weapons use risen to the level of customary international law? If so, how should this customary law impact the design of an autonomous weapon system?

III. WHAT MAKES A WEAPON LEGAL?

Regardless of whether a state has a legal right to use force, a state must use a legal weapon system and then employ such a system in a legal manner. The initial part of this analysis asks whether the weapon system is legal *per se*, or legal by its very nature and design. [13] In other words, do *any* circumstances exist in which the weapon can be employed or used in compliance with the laws of war? If not, military professionals need not go any further into *jus in bello* rules and evaluate whether it is legal to use a weapon system in a particular context (targeting law) because the weapon system is illegal in each and every context. So just how bad would a weapon system have to be to rise to this illegal level? First, international humanitarian law prohibits weapon systems used in an armed conflict that cause *unnecessary suffering* or superfluous injury. Second, IHL forbids indiscriminate weapon systems. Let us now examine each of these aspects within the context of an autonomous weapon system.

Before beginning, it is important to remember that not all autonomous systems are autonomous weapon systems. Indeed, the majority of autonomous robots currently used by the U.S. military do not fall into the category of a weapon system. Under international law, weapons are any system capable of applying an offensive capability to a target. [14]

Thus, ISR platforms or small robots designed to disarm IEDs do not qualify as a weapon system.

So does this mean UAVs that only possess an ISR platform are immune from legal review? No. Article 36 of the First Additional Protocol to the Geneva Convention (API) requires states to determine the legality of any “new weapon, means or method of warfare.” [15] The *means* aspect of this Article 36 review requires a look at not just the weapon itself but also any system or equipment that delivers force to the adversary. [16] Thus, an autonomous system that provides ISR capabilities utilized by an offensive weapon system (like an F-35) would fall within the “means” umbrella and require a legal review. [17] The *methods* terminology requires states to review the ways in which weapons are used in armed conflict. [18] Put another way, methods include the tactics, techniques and procedures associated with any new ways of warfare. [19]

While the United States has not ratified API, it has recognized many aspects of the treaty as customary international law, including the requirement to conduct a legal review on all weapon systems and means of warfare. [20] DoD Directive 5000.01, which governs the defense acquisition system, requires a legal review be conducted on all weapon systems to ensure compliance with U.S. treaty obligations and customary international law. [21] Service guidance, such as Air Force Instruction 51-402, then governs the request and conduct of the legal review. In general, after understanding the intended use for a weapon system, the attorney assesses whether the weapon could cause unnecessary suffering and whether the weapon is “capable of being directed against a specific military objective....” [22]

Weapons that produce unnecessary or superfluous suffering are prohibited by Article 35(2) of API and the Hague Convention (IV) respecting the Laws and Customs of War on Land. Though the U.S. has not ratified API, the United States (and the world community of states) considers the prohibition against unnecessary suffering to be a binding customary international law principle. [23] This provision is aimed at reducing pain and suffering on the battlefield and prohibits the design of weapons aimed to cause suffering simply for the sake of suffering. Examples of weapons banned under this provision include fragmentary weapons and explosives that project glass shards. While some commentators have opined that the idea of being killed by an autonomous system is somehow “worse” than a death caused by a human soldier, that notion has not gained much traction by most international law scholars. [24] Thus, unless a UAV or UGV is outfitted with an illegal weapon suite, the principle of unnecessary suffering will not pose much of a hurdle to autonomous weapons.

The major challenge to autonomous weapon systems will be that of discrimination. Article 51 of API requires that a weapon system be capable of being directed at a specific military target and that its effects be limited as required by API. [25] Put simply, this requires that a weapon be capable of being aimed and that its effects be controllable. [26] Biological weapons are the quintessential example of a weapon whose effects cannot be controlled. Once such a weapon is released, its operator has no ability to control whether civilians or military are impacted by the biological

effects; as such, a biological weapon system is considered indiscriminate. Likewise a missile that has absolutely no guidance and control system and is incapable of being aimed would be an indiscriminate weapon and be considered illegal *per se*.

So can an autonomous weapon system pass these discrimination requirements? Most likely. Assuming that the effects of an autonomous weapon are in line with a typical conventional warhead and that the weapon is capable of either being aimed (through human control) or aiming itself (based on programming), an autonomous weapon system meets the definition of a discriminate weapon. Engineers should be ready to explain how the sensors and guidance system technology enable the autonomous weapon system to be aimed and direct its attack at a military target. [27] Somewhat counterintuitively, the AWS does not have to be capable of distinguishing between civilian and military targets in order to be a *per se* legal weapon system. [28] At this stage of the analysis, attorneys are determining whether any environment exists such that the weapon could be legally employed. Thus, as long as the AWS can be aimed, the system can be considered legal because it may only be used in a battlespace comprised exclusively of military targets and void of all civilians and civilian objects. [29] If an AWS cannot distinguish between civilian and military targets, the system may not be legal to employ in a particular context like an urban environment. That analysis, however, is taken up in the next section on targeting law and does not change the conclusion of whether an AWS is legal *per se*.

Current non-autonomous weapon system legal reviews would conclude their analysis with unnecessary suffering and discrimination analysis, but with autonomous systems, one additional area may need to be explored—the IHL concept of precaution. Precaution requires the planners and executors of an attack to take certain steps to minimize risk to civilians and civilian objects. [30] Details about what precautions are required under IHL are explained more thoroughly in the next section because normally precaution is handled from a legal perspective when dealing with specific targeting and not at the time of the initial weapon review. Indeed this makes sense with non-autonomous systems because the human operator needs to take precautions much closer to weapons employment.

For autonomous weapon systems, however, a determination must be made at the time of the legal review about whether the system will ever be allowed to make an independent decision to target. If so, then the AWS must be able to satisfy the precaution requirements discussed in the targeting law section in order to be a legal weapon system. [31] At this stage of technological development, AWS are not capable of meeting the legal requirements of precaution without a human in-the-loop. [32] Indeed, DoD Directive 3000.09 requires a legal review to be conducted on any such AWS that would have such capabilities prior to development and again before fielding. [33] As such, the concept of precaution will remain solely within the realm of the legal review done at targeting or employment for the foreseeable future. Engineers, however, should be aware that development of autonomous weapon systems that moves the

responsibility of precautions away from the human operator and to the machine will require substantial legal review.

After reviewing the principles of unnecessary suffering and discrimination (and maybe at some point precaution), an attorney finalizing a weapons legal review will also review any applicable domestic law, binding international law treaties, and relevant customary international law provisions. Currently, no specific treaty regarding autonomous weapon systems has occurred in the international community although calls have been made to do so. [34] Customary international law, regarding the legality of weapons with wide-spread, long-term damage to the environment is evolving. [35] Engineers should inquire about the current state of such law, especially if they are aware of particular aspects of the weapon that cause wide-spread, long-lasting or severe environmental issues.

So when does this legal analysis begin for weapons? It actually starts very early in the development of a weapon system lifecycle. Article 36 requires countries to evaluate the legality of potential weapon systems at the “study, development, and acquisition or adoption stages in the weapons procurement process.” [36] Thus, engineers and acquisition officials need to engage early and often with attorneys to ensure proper analysis is being conducted regarding whether a new weapon system or means of warfare is legal *per se*.

Engineers should expect that lawyers will need to know and understand a range of technical data regarding the weapon system including: a full description of the weapon, the reliability and accuracy of the weapon, the type of destructive mechanism and expected injuries, and a description of the weapon’s intended use. [37] Later in the acquisition process, as the weapon is closer to fielding, engineers will also need to share test data, to include modeling and simulation results, regarding the accuracy, reliability and performance of the system. [38] Most importantly, developers, operators and attorneys must have a similar understanding about how humans will be involved in the control of the system. In other words, just how autonomous will the AWS be?

Questions engineers should to ask lawyers regarding legality of a weapon system:

- What performance or testing data do you need to show that this AWS is capable of being aimed?
- What performance or testing data about the warhead do you need to show that the effects of this weapon are consistent with IHL?
- What, if any, information do you need about environmental impacts of this AWS?

IV. WHAT MAKES A WEAPON LEGAL TO EMPLOY?

Even if a weapon has been deemed “legal,” that does not mean the weapon is legal to use in every instance. To determine if a weapon system is legal to employ, we must turn to the IHL governing targeting. Law in this area “comprises prohibitions, restrictions, and obligations designed to balance a State’s interest in effectively

prosecuting the war (military necessity) with its interests in minimizing harm to those involved in conflict (humanity).” [39] To strike this balance, the law looks at two key principles: distinction and proportionality. [40]

Distinction comes into play again under the law of targeting, but this time it is taken in the context of a specific target. Article 48 of API, which is also customary international law, prohibits the targeting of the civilian population or of *civilian objects* (anything that is not a military objective is considered a civilian object.) [41] Put simply, one can only target military people or things. Under Article 52 of API, a military objective is anything whose “nature, location, purpose or use” effectively contributes to the enemy’s military action and whose targeting would create a definite military advantage. [42] Thus, autonomous weapon systems employed in an environment where civilians or civilian objects may be present must possess enough sensory ability to distinguish between civilian objects and military objectives. Additionally, AWS targeting algorithms must prohibit specific, intentional targeting of civilians.

Engineers and software designers reading this are now wondering, “so how certain does the system need to be when it distinguishes between a civilian and military object?” Error, as every engineer knows, is simply part of technical design and exists at some level in every control loop. While no mathematical or quantitative answers exist to the question of how much error is acceptable, the law does not require perfection. As Professor Michael Schmitt noted, “[n]either the human nor the machine is held to a standard of perfection; in the law of armed conflict the standard is always one of reasonableness.” [43]

The law thinks about error using a concept call *doubt*. The amount of doubt that should stop an attack is that amount that would cause another reasonable operator (Soldier or Airman) to stop the attack. [44] A reasonable Soldier or Airman is one who utilizes all reasonably available sources of information to understand what the target is, evaluates the military value of the target, and assesses whether the target needs to be engaged today versus another time given the overall uncertainty. [45] Making matters more difficult for engineers, the level of acceptable doubt is not static but instead will vary as the level of military advantage varies. [46] Designers will also need to consider how doubt gets resolved across multiple unmanned platforms as well as in the context of manned-unmanned teams.

International law specifically contemplates—or as some scholars have articulated the law “expect[s] and tolerate[s]”—that some civilians will die in an armed conflict and civilian objects will be destroyed. [47] The legal term for such occurrences is called *collateral damage*. [48] The decision on whether to target a military objective despite knowing that civilians may die incidentally in the process is evaluated under the principle of *proportionality*. Intentionally targeting a military objective is proportional and legal so long as the expected collateral damage is not excessive when compared to the anticipated “concrete and direct” military advantage gained. [49] Thus, the greater the military advantage of striking or destroying a military target, the more tolerance the law has for causing harm to civilians. [50]

For autonomous weapon systems, this balancing is extraordinarily difficult because it requires an assessment of military advantage. Such an assessment requires value judgments to be placed on the importance of a particular target to the overall operation at a particular point in time. [51] This requires making a hypothesis about the expected advantage to be gained based on specific facts known about the overall military operation and the particular target. In other words, evaluating military advantage requires reasoning that extracts general principles from specific instances. Engineers may know this as inductive reasoning—something robots have yet to achieve. Furthermore, the anticipated military advantage is not a tactical level determination that merely looks at the current battlefield and weighs the importance of a particular target; instead, military advantage must be viewed in a broader context of overall operational or campaign level advantage. [52] Thus, even if an AWS was capable of making such a military advantage assessment on its own, the system would need information and intelligence feeds in order to assess the operational impacts, not just the tactical ones.

Combatants are also required to take all *feasible efforts* or *precautions* to avoid or minimize collateral damage. [53] Article 57 of API explains a variety of precautions required when applying force to a target. [54] For instance, the attacker must exercise “constant care. . . to spare” civilians and civilian property and should provide a warning to civilians prior to attack wherever feasible. [55] Targeting law also requires selection of the most feasible means of warfare that will cause the least amount of harm to civilians. [56] Similar to the proportionality analysis, taking all feasible precautions requires a great deal of judgment and complex decision-making...likely dependent on inductive reasoning. Given the status of technology today and autonomous weapon systems’ inability to assess such subjective and qualitative factors, engineers should focus on facilitating how the human operator can properly provide precaution decisions to the AWS in order to comply with IHL. [57]

If targeting law presents so many challenges to autonomous weapons systems, how is it that Predators and other unmanned platforms are in use today? The answer lies in where the targeting decision occurs. Today, the U.S. military does not operate fully autonomous offensive weapon systems that independently select and then engage targets without human authorization. [58] Instead humans have a role in target engagement either through supervision of the system (for time-critical defensive operations) or as part of the control loop in semi-autonomous platforms. [59] As technology progresses, however, it is critically important that engineers understand the basic structure of applicable targeting law prior to development of lethal autonomous weapon systems.

Questions engineers should to ask lawyers regarding targeting or employment of AWS:

- How certain does the autonomous weapon system need to be about target identification? What factors should be considered when resolving doubt about a target? Should the system be designed to allow the level of acceptable doubt to be changed depending on the particular stage of the conflict? Should the system

be required to use multiple sources of intelligence to identify the target positively?

- With respect to distinction and resolving doubt about whether the identified target is military or civilian, what factors should the system analyze when assessing the military advantage of a potential target?
- With respect to distinction and working in manned-unmanned teams, how should the AWS handle a situation where the unmanned platform identifies an object as civilian but the human operator part of the team identifies the object as a military target? Can the human operator trump or override the robot’s analysis?
- With respect to proportionality, does the system need a sliding scale for collateral damage tolerances or are preset levels for collateral damage acceptability satisfactory? How many levels are needed and how quickly does the system need to respond to changes in those levels?
- Is it acceptable if the system applies robotic learning to military advantage of various targets? Why or why not?
- What criteria is used to determine if collateral damage is excessive? Will the AWS be expected to analyze any of that criteria? Will the AWS be expected to analyze potential indirect or second and third order effects?
- What aspects of targeting identification need to be tested through live testing versus modeling and simulation?
- What type of information will the system need to be able to receive regarding targeting precautions? Is there a desired default position on whether or not to engage a target if precaution information/confirmation has not been received?

V. CONCLUSION

The first shot freely taken by a robot will be a shot heard round the world. It will change war, and maybe society, forever.

- Nicholas Carr, *The Glass Cage* [60]

While robotics engineers are the first to admit that the ability of a fully autonomous weapon system to identify, select, and then engage an enemy target without human intervention is still sometime in the distant future, the need to understand how autonomy and international law coincide and interact exists today. Engineers must embrace a rich understanding of international law principles in order to develop more capable systems that comply with global norms. For all the debate of “killer robots” and the legal and ethical implications of lethal autonomous weapon systems, I remain confident that mankind will find an acceptable path—both legally and ethically. When engineers, attorneys, and commanders work together and communicate in the same

language, they will spark the inquiry and examination necessary to find solutions to tough problems and retain the balance that just war theory demands. And in the end, they just might get through those pearly gates.

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- [8] Lydia de Beer, ed., *Unmanned Aircraft Systems (Drones) and Law* (Nijmegen, The Netherlands: Wolf Legal Publishers, 2011), 14.
- [9] Schmitt, "The Drone Debate Matures," 5. Note that IHRL is also applicable during an armed conflict as well in that this body of law fills in any gaps left by IHL. In cases where international humanitarian law permits greater flexibility for use of force in an armed conflict, IHL trumps. The U.S. recently agreed that IHRL co-exists with IHL even in armed conflicts. *Id.*, 7-8.
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- [14] William H. Boothby, *Weapons and The Law of Armed Conflict* (Oxford: Oxford University Press, 2009), 4. Some commentators do not even consider a Predator as a weapon system but rather a platform for delivery of a weapon. David Turns, "Droning On," 199. Regardless of semantics, it is clear that UAVs or other autonomous systems that deliver force require legal review either as a weapon system or a means of warfare.
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- [26] Schmitt and Thurnher, "Out of the Loop," 246, 249.
- [27] Boothby, *Weapons and The Law of Armed Conflict*, 231.
- [28] Schmitt and Thurnher, "Out of the Loop," 246.
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- [30] API, Article 57.
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- [32] *Ibid.*, 233.
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- [34] Armin Krishnan, *Killer Robots: Legality and Ethicality of Autonomous Weapons* (Bodmin, Cornwall: Ashgate Publishing, 2009), 157.
- [35] Boothby, *Weapons and The Law of Armed Conflict*, 86-105.
- [36] *Ibid.*, 344.
- [37] *Ibid.*, 349.
- [38] *Ibid.*, 349-50.
- [39] Schmitt and Thurnher, "Out of the Loop," 232.
- [40] *Jus in bello* also contains concepts of military necessity and perfidy (fighting fairly). The former is generally addressed as one completes a distinction and proportionality assessment. *Ibid.*, 258-59. Perfidy prohibits misuse of international law principles in order to trick the enemy. Thus, UAVs with a weapons payload cannot have a Red Cross symbol on it. Turns, "Droning On," 207.
- [41] API, Article 52(1).
- [42] API, Article 52(2); Turns, "Droning On," 204-05.
- [43] Schmitt and Thurnher, "Out of the Loop," 257.
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- [54] API Article 57.
- [55] Boothby, *Weapons and The Law of Armed Conflict*, 232-33.
- [56] Schmitt and Thurnher, "Out of the Loop," 261.
- [57] Boothby, *Weapons and The Law of Armed Conflict*, 233.
- [58] Schmitt and Thurnher, "Out of the Loop," 237, 269-70.
- [59] DoDD 3000.09, para 4(c).
- [60] Nicholas Carr, *The Glass Cage: Automation and Us* (New York: W.W. Norton & Company, 2014), 193.