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Lethal Autonomous Weapons Systems: The Case For International Prohibition

Kenneth Brandon Turner

LETHAL AUTONOMOUS WEAPONS SYSTEMS:

THE CASE FOR INTERNATIONAL PROHIBITION

A Masters Thesis

Presented to

The Graduate College of

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In Partial Fulfillment

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Master of Science, Defense and Strategic Studies

By

Kenneth B. Turner

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ABSTRACT

In October of 2001, an American unmanned aerial vehicle was credited with the first 'kill' by a drone strike, setting off an enduring debate on the role of unmanned systems in warfare. Over a decade later, the number and capability of unmanned systems have grown and are rapidly expanding in use worldwide, the proliferation of weaponized 'drones' now extending to non-state actors as well as nation-states. This thesis examines the current and future state of lethal autonomous weapons systems (LAWS) and the argument that the development and deployment of LAWS should be subject to an international prohibition until the facets of their use are more completely understood. Because of a lack of consensus on even basic issues surrounding LAWS, a ban on LAWS at this time appears premature and the U.S. could advocate for transparency and confidence building measures as an interim step while discussion on the issues continues.

KEYWORDS: Lethal Autonomous Weapons Systems, LAWS, unmanned systems, killer robots, drones, UAV

This abstract is approved as to form and content

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John Rose, PhD
Chairperson, Advisory Committee
Missouri State University

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Approved:

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John Rose, PhD

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Dennis Bowden, MA

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David Trachtenberg, MS

_____
Julie Masterson, PhD: Dean, Graduate College

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EXECUTIVE SUMMARY

On 7 October 2001, an American MQ-1 Predator, tail fin #3034, unmanned aerial vehicle was credited with the first 'kill' by a drone strike, ushering armed unmanned systems onto the battlefield and setting off an enduring debate on the role of unmanned systems in warfare.[1] Nearly a decade and a half later, the number and capability of unmanned systems have grown and expanded in use worldwide, the proliferation of weaponized 'drones' set to touch off an international arms race as nation-states and non-state actors vie for an edge over their opponents' systems. To that end, increasing levels of autonomy in unmanned systems are seen as a deciding factor in the battlefields of the near future.

The perceived culmination of this marriage of weaponized unmanned systems and increasing levels of autonomy are near-future systems that can select and engage targets without the need for human input, known as lethal autonomous weapons systems (LAWS). Governments, nongovernmental organizations, and concerned citizens from a wide swath of backgrounds have urged the international community to establish a prohibition on the development of LAWS, driven by concerns that the decision to take a human's life will be removed from human control and given to machines. The case for an international prohibition of LAWS has been given recent high profile attention in a series of Meeting of Experts on LAWS at the United Nations Convention on Certain Conventional Weapons (CCW), which will likely inform the debate on LAWS going forward.

[1] Chris Woods, "The Story Behind America's First Drone Strike," *The Atlantic*, May 30, 2015, http://www.theatlantic.com/international/archive/2015/05/america-first-drone-strike-afghanistan/394463/.

In discussing the issue before the Meeting of Experts on LAWS, there has been a drive to raise awareness of the issues surrounding LAWS and build consensus that would inform the development of a prohibition of LAWS. Yet there have been problems in getting representatives to the meetings to come to a general agreement on even the most basic of issues, including what systems they are even discussing. This is further exacerbated when delving into the issue of autonomy in weapons systems and the drivers for increasing autonomy for military use. Additionally, there is concern over what would qualify as meaningful human control of LAWS and how such systems might violate international humanitarian law.

As the perceived precursor to LAWS, the development and deployment of unmanned systems has colored the opinions of representatives to the Meeting of Experts on LAWS. The short developmental history of unmanned systems beginning in the shadow of World War I and II, has given the systems an air of technological mystique and novelty. The rapid adoption of unmanned systems by the U.S. military and the culmination of technology and commercial viability has fueled a burgeoning international market for the systems, both weaponized and not. Yet it is the public perception of 'drone warfare' and arguments over its efficacy, that has driven much of the conversation at the Meeting of Experts on LAWS.

Despite a lack of consensus on these issues, some representatives at the Meeting of Experts on LAWS continue to call for an immediate international prohibition on the development of LAWS. Proponents argue that the many issues surrounding LAWS, such as meaningful human control, autonomy, and concerns under international humanitarian law, warrant a prohibition of the systems. In supporting their calls for a prohibition,

proponents have suggested that previous international efforts at arms control could serve as the building block for a new international prohibition of LAWS. Proponents point to Protocol IV of the UN Convention on Certain Conventional Weapons, the Ottawa Process surrounding the Mine Ban Treaty, and the arguments made in the international effort to rid the world of weapons of mass destruction, as examples of how and why an international prohibition of LAWS would work. In opposition to an international prohibition, opponents have argued that the existing laws of armed conflict are sufficient in addressing concerns over LAWS or that such a ban would not be feasible, either politically or technically. Opponents contend that if done correctly LAWS could potentially be more ethical than human soldiers in armed conflict and that a preemptive prohibition would ultimately harm many efforts in developing autonomy.

As the representatives of the High Contracting Parties to the UN Convention on Certain Conventional Weapons prepare to meet at the 2016 Fifth Review Conference in Geneva from 12-16 December 2016, the topic of LAWS and the calls for an international prohibition will dominate much of the discourse over the week. Yet as both proponents and opponents of an international prohibition of LAWS make their case before the 2016 Fifth Review Conference, there is a clear need for a better understanding of and a certain level of consensus built regarding the issues surrounding LAWS. It is vitally important that the issue of LAWS is adequately and clearly discussed and that the central terms and issues are well defined beyond the hyperbolic filled mess that has been the current discourse on LAWS, before the international community should consider making a decision on an international prohibition on the development and deployment of LAWS.

LETHAL AUTONOMOUS WEAPONS SYSTEMS

In the ongoing debate over lethal autonomous weapons systems (LAWS), there is no shortage of issues for parties at the UN Convention on Certain Conventional Weapons' (CCW) Meeting of Experts on LAWS to discuss. Over the past three years' meetings addressing this issue have attempted to build consensus on several central issues. While there is certainly no deficit of definitions for LAWS, there are a few common themes that should inform a working definition for use in future meetings. Perhaps one of the biggest hurdles to meaningful discussion on LAWS, is the lack of clear understanding surrounding autonomy and the inclination to build a one-size fits all metric for autonomous systems. Additionally, while there are potentially some drivers for developing increasingly autonomous systems for military use, there are other reasons why the military might shy away from them. There are also the issues of what defines meaningful human control and to what extent LAWS are thought to violate international law. It is important to keep in mind that both proponents and opponents of a ban on LAWS agree that many of the issues raised regarding LAWS in this chapter are areas of concern that need to be addressed, however the two sides ultimately diverge on their views of the technology and the best courses of action to address the issues.

The UN CCW Meeting of Experts on LAWS

The UN CCW, the full title of which is the United Nations 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, was drafted in

October 1980 and entered into force in December 1983 with 122 nation-states having ratified or acceded to the treaty.[2] The CCW has two general purposes: "to ban or restrict the use of specific types of weapons that are considered to cause unnecessary or unjustifiable suffering to combatants or to affect civilians indiscriminately."[3] The CCW has five protocols: [4]

- Protocol I: prohibits the use of weapons with non-detectable fragments.
- Protocol II: prohibits or restricts the use of landmines, booby traps, and other devices.
- Protocol III: prohibits or restricts the use of incendiary weapons.
- Protocol IV: prohibits the use of blinding laser weapons.
- Protocol V: obligates states to clear explosive remnants of war.

Of the five protocols, Protocol II and Protocol V have separate, parallel implementation processes that work in tandem with the implementation processes of the entire CCW.[5] There are annual Meetings of the High Contracting (State) Parties and Review Conferences every five years that review the operation and protocols of the CCW and mandate and review any work done by the Group of Government Experts (GGE) on a mandated topic.[6] The CCW meetings are open to all state parties to the CCW, as well as any non-party states or any relevant international and non-governmental organizations

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[2] United Nations, "United Nations 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," *United Nations Office for Disarmament Affairs,* accessed May 23, 2016, http://disarmament.un.org/treaties/t/ccwc.

[3] United Nations, "The Convention on Certain Conventional Weapons," *United Nations Office at Geneva,* accessed May 23, 2016, http://www.unog.ch/80256EE600585943/%28httpPages%29/4F0DEF093B4860B4C1257180004B1B30?OpenDocument.

[4] *Ibid.*

[5] United Nations, "Meetings of the States parties," *United Nations Office at Geneva,* accessed May 23, 2016, http://www.unog.ch/80256EE600585943/%28httpPages%29/CE461DB2A1D128A5C12573CD004DB6F3?OpenDocument.

[6] *Ibid.*

(NGO), who may participate as observers.[7]

The issue of LAWS was brought to the high-profile attention of the international community by the Human Rights Watch report, *Losing Humanity: The Case Against Killer Robots*, published on 19 November 2012.[8] On 9 April 2013 the UN Special Rapporteur on Extrajudicial, Summary, or Arbitrary Execution, Christof Heyns, released his report on lethal autonomous robots, which was presented to the UN Human Rights Council on 29 May 2013.[9] At the UN Human Rights Council presentation, Brazil and France proposed the CCW as the appropriate venue for continuing the discussion on LAWS,[10] which was further highlighted by the October 2013 session of the UN General Assembly First Committee on Disarmament and International Security.[11] In the opening statement before the 2013 Meeting of the High Contracting Parties to the CCW on 11 November 2013, UN Secretary-General Ban Ki-Moon urged the state parties to "remain vigilant in addressing the implications of new and emerging weapons and their technologies. I particularly encourage you to further engage in dialogue on all aspects of the issue of autonomous weapons systems, to better understand their potentially grave humanitarian impact and to consider their implications in the context of international humanitarian law and the Convention."[12]

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[7] *Ibid.*
[8] Human Rights Watch, "Losing Humanity: The Case Against Killer Robots," *Human Rights Watch*, April 29, 2015, https://www.hrw.org/report/2012/11/19/losing-humanity/case-against-killer-robots.
[9] Christof Heyns, "Report of the Special Rapporteur on extradjudicial, summary or arbitrary executions, Christof Heyns," *United Nations,* April 9,2013, http://www.ohchr.org/Documents/HRBodies/HRCouncil/RegularSession/Session23/A-HRC-23-47_en.pdf, p. 7-8.," p. 1.
[10] Campaign to Stop Killer Robots, "Consensus Killer Robots Must Be Addressed," *Campaign to Stop Killer Robots*, May 28, 2013, https://www.stopkillerrobots.org/2013/05/nations-to-debate-killer-robots-at-un/.
[11] Campaign to Stop Killer Robots, "More States Speak out at UN," *Campaign to Stop Killer Robots*, October 30, 2013, https://www.stopkillerrobots.org/2013/10/unga2013/.
[12] Ban Ki-Moon, "United Nations Secretary-General Ban Ki-Moon's Statements," *United Nations*, November 14, 2013, http://www.un.org/sg/statements/?nid=7276.

During the 2013 Meeting of the High Contracting Parties to the CCW on 11-15 November 2013, the Chairperson, Mr. Jean-Hugues Simon-Michel, Ambassador of France, negotiated an agreement for a new mandate on the subject of LAWS.[13] The mandate states that "the Chairperson will convene in 2014 a four-day informal Meeting of Experts, from 13 to 16 May 2014, to discuss the questions related to emerging technologies in the area of lethal autonomous weapons systems, in the context of the objectives and purposes of the Convention. He will, under his own responsibility, submit a report to the 2014 Meeting of the High Contracting Parties to the Convention, objectively reflecting the discussions held."[14] The UN CCW Meeting of Experts on LAWS first met in Geneva from 13 to 16 May 2014 and has since met on 13 to 17 April 2015 and 11 to 15 April 2016, renewing the mandate to reconvene the following year to continue discussing questions regarding LAWS. Interest and attendance in the Meetings of Experts has risen over the three years, from 87 states in 2014, to 90 states in 2015, to 94 states in 2016.[15]

As the primary vehicle at the international level for the ongoing discussion on LAWS, parties to the UN CCW Meeting of Experts on LAWS have debated numerous facets of the development and deployment of LAWS over the last three years. The 2014 Meeting of Experts on LAWS discussed technical issues, ethics and sociology, legal aspects under international humanitarian law and other international laws, and

[13] United Nations, "Report of the 2014 informal Meeting of Experts on Lethal Autonomous Weapons Systems (LAWS)," *United Nations,* June 11, 2014, https://documents-dds-ny.un.org/doc/UNDOC/GEN/G14/048/96/PDF/G1404896.pdf?OpenElement, p. 1.
[14] *Ibid.*
[15] Campaign to Stop Killer Robots, "Ban Support Grows, Process Goes Slow," *Campaign to Stop Killer Robots*, April 15, 2016, https://www.stopkillerrobots.org/2016/04/thirdmtg/.

operational and military aspects.[16] The 2015 Meeting of Experts on LAWS deliberated again on technical issues and international humanitarian law, but also discussed the characteristics of LAWS, the issue of transparency in weapons development, and general overarching issues regarding LAWS.[17] The 2016 Meeting of Experts on LAWS debated mapping autonomy, a working definition of LAWS, challenges to international humanitarian law, human rights and ethical issues, and security issues.[18] Since May 2013 at least 67 state parties have now officially spoken publicly on LAWS in an international forum, mostly at the Meeting of Experts, the UN General Assembly, or the Human Rights Council.[19] While some of the 67 state parties that have spoken publicly on LAWS have decided either to support or oppose a ban on LAWS, the attitude of many governments appears to be somewhere in the middle.

Following the 2016 Meeting of Experts, there are now 14 state parties outright seeking a preemptive international prohibition on the development and deployment of LAWS, though several other states have voiced interest in considering at least some level of restriction. The 14 states calling for a preemptive ban are: Algeria, Bolivia, Chile, Costa Rica, Cuba, Ecuador, Egypt, Ghana, Holy See, Mexico, Nicaragua, Pakistan, State

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[16] United Nations, "2014 Meeting of Experts on LAWS," *United Nations Office at Geneva,* accessed May 23, 2016, http://www.unog.ch/__80256ee600585943.nsf/%28httpPages%29/a038dea1da906f9dc1257dd90042e261?OpenDocument&ExpandSection=1#_Section1.

[17] United Nations, "2015 Meeting of Experts on LAWS," *United Nations Office at Geneva,* accessed May 23, 2016, http://www.unog.ch/80256EE600585943/%28httpPages%29/6CE049BE22EC75A2C1257C8D00513E26?OpenDocument.

[18] United Nations, "2016 Meeting of Experts on LAWS," *United Nations Office at Geneva,* accessed May 23, 2016, http://www.unog.ch/80256EE600585943/%28httpPages%29/37D51189AC4FB6E1C1257F4D004CAFB2?OpenDocument.

[19] Campaign to Stop Killer Robots, "Country Views on Killer Robots," *Campaign to Stop Killer Robots,* April 14, 2016, http://www.stopkillerrobots.org/wp-content/uploads/2016/04/CountryViews_14Apr2016.pdf, p. 1.

of Palestine, and Zimbabwe.[20] Additionally there are numerous NGOs, academics, scientists, and other individuals who are also calling for a preemptive ban on LAWS. The Campaign to Stop Killer Robots, which calls for an outright ban of LAWS, is an international coalition of 61 international, regional, and national NGOs, which includes notable organizations such as Human Rights Watch, Amnesty International, and the Women's International League for Peace and Freedom.[21] More than 3,000 professional artificial intelligence and robotics researchers have signed an open letter from the Future of Life Institute that calls for a "ban on offensive autonomous weapons beyond meaningful human control."[22] Notable signatories to the letter include Google DeepMind CEO Demis Hassabis, Tesla CEO Elon Musk, Professor Stephen Hawking, and several presidents of artificial intelligence and robotics professional organizations.[23]

While the proponents of a prohibition on LAWS appear to be in the majority vocally at the UN CCW Meeting of Experts on LAWS, there has been some opposition, particularly to a preemptive outright ban of LAWS. Although some parties to the UN CCW Meeting of Experts on LAWS have expressed skepticism or cautioned against a rush to impose a ban, the United Kingdom is perhaps the only country which has vocally opposed a prohibition.[24] The British government has stated that "at present, we do not see the need for a prohibition on the use of LAWS, as international humanitarian law already

[20] "Ban Support Grows, Process Goes Slow."
[21] Campaign to Stop Killer Robots, "Who We Are," *Campaign to Stop Killer Robots*, accessed May 23, 2016, http://www.stopkillerrobots.org/coalition/.
[22] Future of Life Institute, "Open Letter on Autonomous Weapons," *Future of Life Institute*, accessed May 23, 2016, http://futureoflife.org/open-letter-autonomous-weapons.
[23] *Ibid.*
[24]Owen Bowcott, "UK Opposes International Ban on Developing 'killer robots,'" *The Guardian*, April 14, 2015, http://www.theguardian.com/politics/2015/apr/13/uk-opposes-international-ban-on-developing-killer-robots.

provides sufficient regulation for this area."[25] Canada and France have joined the UK in stating that they would not pursue development of LAWS, but have thus far declined to support a prohibition on LAWS.[26]

The U.S. was the first country to issue policy guidance on LAWS, Department of Defense (DoD) Directive 3000.09, in November 2012 and while the document does address many of the obstacles that LAWS would need to overcome for development and deployment, it "neither encourages nor prohibits the development" of such systems in the future.[27] U.S. Deputy Defense Secretary Robert Work recently signaled that the U.S. DoD "will not delegate lethal authority to a machine to make a decision," though he expressed concern that more authoritarian regimes might.[28] The U.S. and Israel are the only two countries thus far to have expressed interest at the UN CCW Meeting of Experts in discussing the potential benefits of continuing to develop and deploy LAWS, yet the U.S. was and has continued to be one of the biggest supporters of the dialogue at the Meeting of Experts.[29] In the U.S. delegation's response to UN Special Rapporteur Christof Heyns' report on lethal autonomous robotics, it was stated that "lethal autonomous weapons may present important legal, policy, and ethical issues, and we call on all states to proceed in a lawful, prudent, and responsible manner when considering whether to incorporate

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[25] *Ibid.*
[26] Mary Wareham, "US Needs to Stop Tiptoeing Around the "Killer Robots" Threat," *Human Rights Watch,* May 5, 2015, https://www.hrw.org/news/2015/05/05/us-needs-stop-tiptoeing-around-killer-robots-threat.
[27] Michael W. Meier, "U.S. Delegation Opening Statement," April 11, 2016, http://www.unog.ch/80256EDD006B8954/%28httpAssets%29/EFF7036380934E5EC1257F920057989A/$file/2016_LAWS+MX_GeneralExchange_Statements_United+States.pdf, p.2.
[28] Dan Lamothe, "The killer robot threat: Pentagon examining how enemy nations could empower machines," *The Washington Post,* March 30, 2016, https://www.washingtonpost.com/news/checkpoint/wp/2016/03/30/the-killer-robot-threat-pentagon-examining-how-enemy-nations-could-empower-machines/.
[29] "US Needs to Stop Tiptoeing Around the "Killer Robots" Threat."

automated and autonomous capabilities in weapon systems."[30] Yet it remains the U.S. view that "it is premature to try and determine where these discussions might or should lead."[31] It appears likely, based on the statements of other countries at the Meeting of Experts, that the U.S. is part of an ambivalent majority on the issue of LAWS.[32]

Toward a Working Definition of LAWS

As the topic of the thesis is somewhat technical in nature and loaded with terminology and acronyms, it is important to attempt to define those terms that will be used in this paper. From the outset however, there is a problem in attempting to offer a single definition of LAWS because there has been a failure to cohesively agree on terminology and definitions for LAWS by those working most closely with the issue. There is fervent domestic and international discussion, both within and out of government, about how exactly LAWS should be defined, in-order to differentiate between an ever increasing number of weapons, vehicles, systems, and levels of control. The sheer volume of discussion and difference in opinion over the definition of LAWS is worthy of an entire paper itself and though it may occupy a comparably small section in this paper, it is not to undermine the importance of the discussion. In attempting to limit confusion in later chapters, we will have to narrow the definable scope.

The UN Institute for Disarmament Research (UNIDIR), in its support to the UN CCW Meeting of Experts on LAWS, researched several aspects of LAWS and noted the

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[30] Campaign to Stop Killer Robots, "Report on outreach on the UN report on 'lethal autonomous robotics'," *Campaign to Stop Killer Robots,* July 31, 2013, http://stopkillerrobots.org/wp-content/uploads/2013/03/KRC_ReportHeynsUN_Jul2013.pdf, p. 22.
[31] "U.S. Delegation Opening Statement."
[32] Campaign to Stop Killer Robots, "Country Policy Positions," *Campaign to Stop Killer Robots,* March 26, 2015, http://www.stopkillerrobots.org/wp-content/uploads/2015/03/KRC_CCWexperts_Countries_25Mar2015.pdf.

increasingly complex uncertainty of terms and definitions used internationally in its resource paper, *Framing Discussions on the Weaponization of Increasingly Autonomous Technologies*:

> An initial hurdle to constructive dialogue on autonomy in weapon systems is that different assessments are made by different States, producers and experts as to where a specific technology sits on the autonomy spectrum. This is compounded by uncertainty surrounding how the object under consideration is labelled: "drones", "robots", "autonomous weapon systems", "killer robots", "lethal autonomous robotics", "lethal and non-lethal" semi- and fully autonomous weapons systems, "supervised autonomy" and other terms. The discussion presently lacks focus, tacking between things (for example, drones, robots and systems), a characteristic (autonomy), and uses (defensive measures? targeting? kill decisions?), in an inconsistent and often confusing way. One of the reasons there are so many different terms being proposed as the object of discussion is that some actors are trying to capture a mix of variables of concern (such as lethality or degree of human control), while others are talking about more general categories of objects. Some feel that the first step for the international community should be to establish shared definitions of categories or particular thresholds of autonomy along the spectrum described above (using terms such as fully autonomous, semi-autonomous, partially autonomous, supervised autonomy or others). However, this is likely to be a long and complex exercise, compounded by the fact that different incompatible definitions already exist.[33]

The footnote to this particular section in the UNIDIR's resource paper takes it a step further and notes that "this lack of conceptual clarity is embedded even in the tenses of verbs used in the literature. Present tense is often employed to describe systems that do not yet exist. This creates significant confusion for the reader in trying to determine the actual state of existing technology."[34] The fact that a UN research institute declined to tackle the issue of terminology and definitions of LAWS, demonstrates the extensive difficulty in trying to move forward on a topic when the nation-states themselves do not even completely agree on what they are even arguing over. This is compounded by a lack

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[33] United Nations Institute for Disarmament Research, "Framing Discussion on the Weaponization of Increasingly Autonomous Technologies," *United Nations Institute for Disarmament Research,* accessed May 23, 2016, http://www.unidir.org/files/publications/pdfs/framing-discussions-on-the-weaponization-of-increasingly-autonomous-technologies-en-606.pdf, p. 3.
[34] *Ibid.*

of agreement among individuals, academia, industry, nongovernmental organizations, and government agencies, not only domestically, but also internationally, as evidenced within the exchanges at the UN CCW Meeting of Experts on LAWS.[35]

Although there is a large number of definitions for LAWS that are available for consideration, most of them are generally only minor variations of one another. In the U.S. DoD Directive 3000.09, *Autonomy in Weapon Systems*, "autonomous weapon systems" are defined 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."[36] The International Committee of the Red Cross defines an "autonomous weapon system" as "any weapon system with autonomy in its critical functions. That is, a weapon system that can select (i.e. search for or detect, identify, track, select) and attack (i.e. use force against, neutralize, damage or destroy) targets without human intervention."[37] The Center for New American Security, a Washington based think tank which has written extensively on the issue of LAWS, defines an "autonomous weapon system" as "a weapon system that, once activated, is intended to select and engage targets where a human has not decided those specific targets are to be engaged."[38] The Holy See has defined an "autonomous weapon system" as "a weapon system capable

[35]http://www.unog.ch/80256EE600585943/%28httpPages%29/37D51189AC4FB6E1C1257F4D004CAFB2?OpenDocument
[36] "Autonomy in Weapon Systems," p. 13.
[37] International Committee of the Red Cross, "View of the International Committee of the Red Cross (ICRC) on autonomous weapon system," *International Committee of the Red Cross,* April 11, 2016, https://www.icrc.org/en/document/views-icrc-autonomous-weapon-system, p. 1.
[38] Paul Scharre and Michael C. Horrowitz, "An Introduction to Autonomy in Weapon Systems," *Center for a New American Security,* February 2015, http://www.cnas.org/sites/default/files/publications-pdf/Ethical%20Autonomy%20Working%20Paper_021015_v02.pdf, p. 16.

of identifying, selecting and triggering action on a target without human supervision."[39] The UN Special Rapporteur on Extrajudicial, Summary, or Arbitrary Execution, Christof Heyns, defined "lethal autonomous robots" as "robotic weapon systems that, once activated, can select and engage targets without further intervention by a human operator. The important element is that the robot has an autonomous 'choice' regarding selection of a target and the use of lethal force."[40] In these five example definitions, they share a common thread that LAWS are weapon systems that can select and engage a target without human intervention, and this generality holds true for most proposed definitions.

The problem with this generality is that it can and has been used by different groups to implicate wide swaths of existing weapons as falling under the purview of the UN CCW Meeting of Experts on LAWS. As an example, the Pakistani delegation in its opening statement before the 2016 Meeting of Experts, remarked that "the states that are currently developing and using LAWS cannot afford to be complacent that such capabilities will not proliferate over time, and hence they too shall become vulnerable."[41] Exacerbating the issue, is that activists describe current unmanned systems as precursors to LAWS without clearly delineating them or by including charged phrases about "killer robots" and "drones" side-by-side in their reports, which stirs the already muddled public perception of what current unmanned systems are.[42] Yet most parties involved in the UN

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[39] The Holy See, "Elements Supporting the Prohibition of Lethal Autonomous Weapons Systems," *The Holy See,* April 7, 2016, http://www.unog.ch/80256EDD006B8954/%28httpAssets%29/752E16C02C9AECE4C1257F8F0040D05A/$file/2016_LAWSMX_CountryPaper_Holy+See.pdf, p.1.

[40] "Report of the Special Rapporteur on extradjudicial, summary or arbitrary executions, Christof Heyns," p. 7-8.

[41] Tehmina Janjua, "Statement by Ambassador Tehmina Janjua, PR of Pakistan," *Pakistan,* accessed May 23, 2016, http://www.unog.ch/80256EDD006B8954/%28httpAssets%29/D6F11030CC982C11C1257F93005933A0/$file/2016_LAWS+MX_GeneralExchange_Statements_Pakistan.pdf, p. 2.

[42] "Losing Humanity: The Case Against Killer Robots."

CCW Meeting of Experts on LAWS generally agree that the focus of the meetings and the eventual definition of LAWS, is not aimed at existing weapons, but rather future weapons following the current trend of automation.[43] The U.S. delegation, in its opening statement before the 2016 Meeting of Experts, articulated this generally accepted stance, noting that "there remain divergent views in the CCW on what weapon systems we are trying to discuss … for the United States, we want to be clear that we are here to talk about future weapons, or in the words of our mandate, 'emerging technologies.'"[44]

Despite devoting an entire section in the 2016 Meeting of Experts to discuss coming up with a working definition of LAWS, a number of parties to the UN CCW Meeting of Experts on LAWS, including the U.S. delegation, have opined that there is generally no need to rush to establish a strict definition of LAWS at this early stage of work on the subject.[45] The opinion holds that while a strict definition might be useful in narrowing discussion on the topic, if previous work on international control regimes are any indicator, parties will continue arguing over definitions long after the ink has dried on the signatures. Still others have argued that attempting to define LAWS is the wrong issue entirely and that we should instead focus on the subject of autonomy in weapon systems, reframing the matter away from the platform and towards the functions being automatized.[46]

In lieu of an agreed upon definition by the concerned parties, this paper will adhere to a broad, definition based on DoD Directive 3000.09's definition of autonomous

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[43] "An Introduction to Autonomy in Weapon Systems," p. 4.
[44] "U.S. Delegation Opening Statement," p. 2.
[45] *Ibid.*
[46] United Nations Institute for Disarmament Research, "Statement of the UN Institute for Disarmament Research," *United Nations Institute for Disarmament Research,* April12, 2016, http://www.unog.ch/80256EDD006B8954/%28httpAssets%29/86C96CC8C7A932DCC1257F930057C0E3/$file/2016_LAWS+MX_GeneralExchange_Statements_UNIDIR.pdf, p. 1.

weapon system and U.S. delegation views, that LAWS are *weaponized unmanned systems that can select and engage a target without human intervention and that these systems, with limited exceptions, do not currently exist.* This allows us to move forward to discussion on levels of autonomy and the issue of "meaningful human control," which has occupied at least as much discussion in the debate.

From Manual to Autonomous

In discussing LAWS, it is important to establish what makes them so markedly different from current unmanned systems. Typically, the debate has fixated on the issue of levels of autonomy and their integration with unmanned systems, which unsurprisingly, is a hotly contested issue within the UN CCW Meeting of Experts on LAWS. There is much confusion perpetuated again, intentionally or otherwise, by the synonymous use of terminology surrounding LAWS which has often made meaningful discussion tenuous. Much of the confusion largely surrounds use of the word "autonomous" and what that means for weaponized unmanned systems.

There are several terms worth defining in pursuing the debate over the autonomous part of LAWS. "Automation" is defined as "the technique of making an apparatus, a process, or a system operate automatically."[47] "Autonomy" (or autonomous) is defined as "the state of existing or acting separately from others, the power or right of a country, group, etc., to govern itself."[48] A "robot" is defined as "a machine capable of carrying out a complex series of actions automatically, especially one programmable by a

[47] "Definition of Automation," *Merriam-Webster*, accessed May 23, 2016, http://www.merriam-webster.com/dictionary/automation.
[48] "Definition of Autonomy," *Merriam-Webster*, accessed May 23, 2016, http://www.merriam-webster.com/dictionary/autonomy.

computer."[49] Although many unmanned systems are indeed robots, this may not necessarily be the case for LAWS, but the term will be used where applicable. There are many applications of automation within society today, from many of the safety features found on cars to the very robots assembling the cars in factories. Automation is also used in unmanned systems, both civilian and military, to traverse predetermined routes, detect and avoid obstacles, or return home (base) should connection with the controller be lost. These tasks and others like them are preprogrammed into an unmanned system to allow certain processes to happen automatically, beyond what is necessary or desired for a human operator to be involved in the operation of the system. Autonomy is the ability or act of performing automated functions by a machine without the need for human input, essentially allowing the machine to function on its own. It is important to remember that this ability to function autonomously is also a preprogrammed process, a procedure created by human programmers or operators for the machine to automatically follow when certain conditions have been met.

It is important to clarify these terms because hyperbolic language used by some advocates for a ban on LAWS has steered into the realm of science fiction and fantasy. Discussion has at times delved deeply into the issue of sentient fully autonomous systems, combining machine learning, artificial intelligence, advanced robotics, and other technologies into cognitive or intelligent systems capable of rationality. Experts are divided on whether advancements along that line of autonomy is even conceivable with existing technology, that it is likely extremely long-term at best, if it is even possible at

[49] "Definition of Robot," *Oxford Dictionary,* accessed May 23, 2016, https://www.oxforddictionaries.com/us/definition/american_english/robot.

all for systems to progress that far.[50] Development of LAWS are not creating the Skynet Terminators of science fiction and discussion insinuating such is not only fanciful, it is distracting from the current issues, and should be disregarded at the outset.[51]

Moving beyond that diversion, next is the issue of levels of autonomy in unmanned systems. Advocates and delegates at the UN CCW Meeting of Experts on LAWS have debated how exactly one categorizes autonomy, in-order to enable a framework that could be used to determine what level(s) of autonomy should be banned. Most proposed level of autonomy lists tends to focus on the human-machine relationship as the primary or sole factor in thinking about autonomy in weapon systems.[52] DoD Directive 3000.09's definition of autonomous weapon systems references and defines "human supervised autonomous weapon systems," but the directive also defines "semi-autonomous weapon systems."[53] "Human supervised autonomous weapon systems" are defined as "an 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."[54] **"**Semi-autonomous weapon systems" are defined as "a weapon system that, once activated, is intended to only engage individual targets or specific target groups that have been selected by a human operator."[55] The National Institute of Standards and Technology

[50] International Committee of the Red Cross, "Autonomous Weapon Systems: Technical, Military, Legal and Humanitarian Aspects," *International Committee of the Red Cross,* November 1, 2014, https://www.icrc.org/en/document/report-icrc-meeting-autonomous-weapon-systems-26-28-march-2014, p. 13-16.
[51] Matt McFarland, "If Killer Robots Arrive, the Terminator Will Be the Least of Our Problems," *Washington Post*, January 25, 2016, https://www.washingtonpost.com/news/innovations/wp/2016/01/25/if-killer-robots-arrive-the-terminator-will-be-the-least-of-our-problems/.
[52] "Losing Humanity: The Case Against Killer Robots."
[53] "Autonomy in Weapon Systems," p. 13.
[54] *Ibid,* p. 14.
[55] *Ibid.*

(NIST) defined and used four levels of "human-robot interaction" in its work to develop an Autonomy Levels for Unmanned Systems Framework: "fully autonomous, semiautonomous, teleoperation, and remote control."[56] The International Committee of the Red Cross noted that most literature on autonomy in weapons systems tended to differentiate three general levels: "remote controlled (or tele-operated), automated, and autonomous."[57] The general idea held by some activists is that there should be a metric that one could use to measure movement from one end of the autonomy spectrum to the other.

Yet the DoD's Defense Science Board (DSB) argued in its *Task Force Report: The Role of Autonomy in DoD Systems* that "the DoD should abandon the debate over definitions of levels of autonomy and embrace a three-facet (cognitive echelon, mission timelines, human-machine system trade spaces) autonomous systems framework."[58] After reviewing many DoD funded studies on levels of autonomy, the DSB concluded that not only was the debate not helpful, but rather it was counterproductive, "because they focus too much attention on the computer rather than on the collaboration between the computer and its operator/supervisor to achieve the desired capabilities and effects."[59] The North Atlantic Treaty Organization's (NATO) Multinational Capability Development Campaign came to a similar conclusion, recommending a framework built around autonomous functions, rather than the classification of systems.[60] Paul Scharre and

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[56] "Autonomy Levels for Unmanned Systems (ALFUS) Framework, Volume I: Terminology," p. 22-23.
[57] "Autonomous Weapon Systems: Technical, Military, Legal and Humanitarian Aspects," p. 62.
[58] U.S. DoD Defense Science Board, "Task Force Report: The Role of Autonomy in DoD Systems," *U.S. DoD Defense Science Board,* July 2012, https://fas.org/irp/agency/dod/dsb/autonomy.pdf, p. 2.
[59] *Ibid,* p. 4.
[60] NATO Multinational Capability Development Campaign 2013-2014, "Policy Guidance: Autonomy in Defence Systems," *NATO Multinational Capability Development Campaign,* October 29, 2014, http://innovationhub-act.org/sites/default/files/u4/Policy%20Guidance%20-%20Autonomy%20in%20Defence%20Systems%20MCDC%202013-2014.pdf, p. 10.

Michael C. Horrowitz at the Center for a New American Security believe it to be more fruitful to think of autonomy as existing not on one scale, but rather several independent ones.[61] Their suggestion is that the scales for autonomy should at least focus on the human-machine relationship, the machine's complexity, and the type of process being automated.[62] They argue that determining the role and extent of human involvement in a machine's automation, recognizing how simplistic or complex the machine being automated is, and identifying the type of process or processes that are being automated, allows a decoupling of many of the arguments over blanket categorizations.[63]

Understanding that automation or autonomy has been used in military systems and unmanned systems for decades, it is important to recognize the intersection of the human-machine relationship, particularly in regards to targeting and engagement, in discussing LAWS. Generally, there are considered three separate intersects of the human and machine relationship: "human-in-the-loop, human-on-the-loop, and human-out-of-the-loop."[64] "Human-in-the-loop" targeting means that an operator has designated specific targets to be engaged and the machine uses autonomy to engage the targets.[65] "Human-on-the-loop" targeting denotes that a machine uses autonomy to select and engage targets without designation by the operator, but that the operator can monitor the machine and intervene at any point.[66] "Human-out-of-the-loop" means that the machine uses autonomy to select and engage targets without designation by the operator and the operator does not have the capability to monitor or intervene.[67]

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[61] "An Introduction to Autonomy in Weapon Systems," p. 5-7.
[62] *Ibid.*
[63] *Ibid.*
[64] "Losing Humanity: The Case Against Killer Robots."
[65] "An Introduction to Autonomy in Weapon Systems," p. 8.
[66] *Ibid.*
[67] *Ibid.*

Human-in-the-loop systems have been used by militaries the world over for decades, the most basic example of which are guided munitions.[68] An operator fires the munition, the munition uses automated processes to correct firing errors, and engages the target.[69] Human-on-the-loop systems are also in use currently, an example being the plethora of active counter-missile systems.[70] These systems target and engage incoming projectiles without the operator's input, but the operator is aware of the system's operation and can deactivate it.[71] Human-out-of-the-loop systems are largely nonexistent in today's militaries, with perhaps the rare existing example being loitering munitions like the Israeli Harpy.[72] Once launched, the Harpy searches a target area for radar coming from radar systems, and once acquiring a positive signature, engages the target, all without an operator to monitor or intervene.[73] In the debate over LAWS, most parties are concerned with the development and deployment of human-out-of-the-loop systems and to a lesser degree, human-on-the-loop systems beyond their current uses.

Another important consideration in discussing autonomy and LAWS is the complexity of the machine that is being autotomized along with the operating environment of the system. Technically speaking, mines are human-out-of-the-loop systems that operate on a very limited concept of targeting, engagement, and freedom of action.[74] Yet while there have been multiple international efforts to ban the use of mines, they are not debated as part of the discussion on LAWS because as a system they are so simplistic as to fall outside the purview. Close-in weapon systems (CIWS) mounted on

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[68] *Ibid.*
[69] *Ibid.*
[70] "Autonomous Weapon Systems: Technical, Military, Legal and Humanitarian Aspects," p. 65-66.
[71] *Ibid.*
[72] "An Introduction to Autonomy in Weapon Systems," p. 13-14.
[73] Peter James Spielmann, "Israeli Killer Robots Could Be Banned Under UN Proposal," *Times of Israel*, May 3, 2013, http://www.timesofisrael.com/israeli-killer-robots-could-be-banned-under-un-proposal/.
[74] "An Introduction to Autonomy in Weapon Systems," p. 14-15.

naval vessels and used to fire upon incoming missiles are relatively more complex systems that can be switched between either human-in or human-on-the-loop modes.[75] Yet the CIWS themselves have such a narrow operating environment, on ships at sea with limited range and limited target sets, that even if they became human-out-of-the-loop systems, there would be little difference from their current state. A very complex system, such as a UAV, with a human-out-of-the-loop system, however, would be cause for great concern in the debate on LAWS. Thankfully no such systems currently exist, nor are there any countries known to be developing them, but such a system is definitely on the minds of the parties debating LAWS.

In considering the type of function or process being automated in regards to LAWS, discussion largely focuses around targeting and engagement of targets. The previously mentioned use of automation by UAVs in take-off, navigation, and landing, allow the individual to at times be considered more operator than pilot, but these complex systems would not become radically more 'dangerous' by making those functions entirely human-out-of-the-loop. It is the automation of the "critical functions" of target acquisition, tracking, selection, and engagement that is cause for concern by activists.[76] As such, the LAWS that both proponents and opponents are concerned with would be a human-out-of-the-loop complex unmanned system that has its critical functions automated.

Drivers of Autonomy

It is important in discussing LAWS to recognize that there are real and valid

[75] "Losing Humanity: The Case Against Killer Robots."
[76] "Autonomous Weapon Systems: Technical, Military, Legal and Humanitarian Aspects," p. 64.

reasons for militaries to pursue increasing levels of autonomy in unmanned systems. Unmanned systems can act as a relatively cheap force multiplier that allows for penetration of adversarial space over long periods of time without placing military personnel at risk, which is just as attractive to the policymaker as it is to the battlefield commander.[77] Yet as the number of unmanned systems, particularly UAVs, have expanded since the beginning of the War on Terror, so too has the support infrastructure needed to sustain them and the limitations that come with it.

One of the reasons driving increasing automation in unmanned systems, is a solution to the number and needs of the human personnel supporting them. Despite being unmanned, many of the unmanned systems in use by the U.S. military today are remote controlled, which means they still require a human at the controls. The flood of UAVs that have entered military service in the last decade and a half and the growing range and number of missions required have severely strained the ability of the pilots to keep pace.[78] U.S. Air Force UAV pilots feel overworked, overstressed, and underappreciated, which when coupled with low recruitment and retention rates, has caused the Air Force to struggle with a shortage of pilots since at least 2007.[79] The number of U.S. Air Force UAV operations has increased fivefold since 2006, requiring an estimated 8,000 service members to support the tempo of operations, yet the Air Force still seeks at least 500 additional pilots alone.[80] Increasing the autonomy of the UAV fleet could reduce the requirements on and numbers of pilots needed to support the systems, which might also

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[77] *Ibid,* p. 69.
[78] W J Hennigan, "Air Force Struggles to Add Drone Pilots and Address Fatigue and Stress," *Los Angeles Times*, November 9, 2015, http://www.latimes.com/nation/la-na-drone-pilot-crisis-20151109-story.html.
[79] *Ibid.*
[80] Ryan Browne, "Air Force Faces Shortage of Drone and Jet Pilots," *CNN*, March 17, 2016, http://www.cnn.com/2016/03/17/politics/air-force-pilot-shortage/.

be attractive cost efficiently as well.[81]

Another reason driving increased autonomy in unmanned systems is the potential to reduce reliance on communication links needed to operate the systems. As the number of UAVs has increased, so too has the need for high-speed bandwidth to enable effective and reliable communication between the operator and the aircraft, which has severely strained military satellite networks and led to increased reliance on commercial satellite services.[82] The communication network between operator and system is also susceptible to disruption, intentional or otherwise. Intentional disruption techniques used against an unmanned system through hacking, jamming, or spoofing, could enable an adversary to disrupt, degrade, or even take control of an unmanned system and use it to their own aims.[83] On 4 December 2011 an American RQ-170 was brought down by the Iranian military by jamming the UAV's communication signal and then spoofing its system into landing inside Iran, all without the need to break U.S. signal data encryption.[84] Even if communications were not disrupted intentionally, it would be desirable to have an unmanned system operate autonomously to some degree in-case of accidental or environmental degradation of the signal, to prevent an accident or loss of a system.[85]

An additional driver of increased autonomy in unmanned systems are the limits of the human operators themselves. The capability of an autonomous system to perform significantly faster than a human operator at certain quantitative tasks, particularly in

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[81] "Autonomous Weapon Systems: Technical, Military, Legal and Humanitarian Aspects," p. 69.
[82] Matthias Bieri and Marcel Dickow, "Lethal Autonomous Weapons Systems: Future Challenges," *Center for Security Studies* (No. 164), November 2014, http://www.css.ethz.ch/content/dam/ethz/special-interest/gess/cis/center-for-securities-studies/pdfs/CSSAnalyse164-EN.pdf, p. 2.
[83] BBC, "Researchers Use Spoofing to 'hack' into a Flying Drone," *BBC*, June 29, 2012, http://www.bbc.com/news/technology-18643134.
[84] Scott Peterson and Payam Faramarzi*, "Exclusive: Iran Hijacked US Drone, Says Iranian Engineer (video)," *The Christian Science Monitor*, December 15, 2011, http://www.csmonitor.com/World/Middle-East/2011/1215/Exclusive-Iran-hijacked-US-drone-says-Iranian-engineer-Video.
[85] "Autonomous Weapon Systems: Technical, Military, Legal and Humanitarian Aspects," p. 70.

regards to decision making and reaction to rapidly escalating situations, is an advantage over adversarial systems controlled solely by human operators.[86] As unmanned systems advance in capability and perhaps one day need to compete in contested environments, the latency between operator and system due to either communication signal or operator limitation could spell the destruction of the system, even more so if the opponent is actively attempting to exploit the signal connection.[87] Other human factors that might influence an operator's capability, "such as the tendency to make mistakes over time, the susceptibility to fatigue and low morale, and the potential for cognition and perception to be impaired by environmental circumstances," might lead to increasing automation of at least many of the repetitive tasks inherent with a remote controlled system.[88]

There are other reasons why increasingly autonomous unmanned systems might make military sense, such as risk reduction for one's own forces, freeing up humans from dull or repetitive nonessential tasks, greater levels of accuracy or reliability in certain tasks, and perhaps even the possibility to respect the laws of war better than humans do.[89]

Yet for all the reasons why autonomy in unmanned systems might make sense or be attractive options for battlefield commanders, there are other reasons why they might shy away from them, particularly from LAWS. Advancements in rapid communication and information sharing have allowed modern battlefield commanders to centralize awareness and control of increasingly lower level tasks, which the use of LAWS would seemingly running counter to, by delegating control out of human hands.[90] Commanders may also be hesitant to trust in the predictability and reliability of LAWS to perform as

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[86] *Ibid.*
[87] "Lethal Autonomous Weapons Systems: Future Challenges," p. 2.
[88] "Autonomous Weapon Systems: Technical, Military, Legal and Humanitarian Aspects," p. 70.
[89] "Framing Discussion on the Weaponization of Increasingly Autonomous Technologies," p. 6.
[90] *Ibid.*

expected in battlefield situations, often under unique and evolving circumstances, where failure might result from any number of potential causes.[91] Additionally, while LAWS could potentially behave more lawfully or more discriminately than humans in battlefield situations, a commander might fear being held accountable for the actions of a system that he may not feel he has control over. These are but a few reasons why despite valid drivers for autonomy, there may be hesitancy in the military to develop and use LAWS.

Meaningful Human Control

One of the recurring themes that has emerged from the UN CCW Meeting of Experts on LAWS is a proposed set of requirements that could be applied to all weapons systems, not just LAWS, to determine whether human operators have a "meaningful level of control of the system."[92] Another major issue in the debate over LAWS and autonomy, is defining "meaningful human control" and how it impacts the development and deployment of autonomy. This litmus test of accountability would be designed to ensure that operators of increasingly autonomous weapons systems are making conscious decisions and remain legally and morally accountable for their decisions and that the systems should be built to account for this.[93]

Yet like so many other issues in discussing LAWS there is little consensus and much confusion about what exactly qualifies as meaningful human control. The UK non-governmental organization (NGO) Article 36 was the first to coin the term meaningful human control, though human control of weapon systems is certainly not a new

[91] "Autonomous Weapon Systems: Technical, Military, Legal and Humanitarian Aspects," p. 71.
[92] Michael C. Horrowitz and Paul Scharre, "Meaningful Human Control in Weapon Systems: A Primer," *Center for a New American Security,* March 2015, http://www.cnas.org/sites/default/files/publications-pdf/Ethical_Autonomy_Working_Paper_031315.pdf, p. 4.
[93] *Ibid.*

concept.[94] The focus of Article 36's meaningful human control was control of individual attacks, believing that undertaking multiple attacks would cause human control to cease to be meaningful.[95] Article 36 laid out three requirements for "meaningful human control:"[96]

- Information – a human operator, and others responsible for attack planning, need to have adequate contextual information on the target area of an attack, information on why any specific object has been suggested as a target for attack, information on mission objectives, and information on the immediate and longer-term weapon effects that will be created from an attack in that context.
- Action – initiating the attack should require a positive action by a human operator.
- Accountability – those responsible for assessing the information and executing the attack need to be accountable for the outcomes of the attack.

The International Committee for Robot Arms Control has also listed three minimum necessary conditions for "meaningful human control," in their statements before the 2014 UN CCW Meeting of Experts on LAWS: [97]

- First, a human commander (or operator) must have full contextual and situational awareness of the target area and be able to perceive and react to any change or unanticipated situations that may have arisen since planning the attack.
- Second, there must be active cognitive participation in the attack and sufficient time for deliberation on the nature of the target, its significance in terms of the necessity and appropriateness of attack, and likely incidental and possible accidental effects of the attack.
- Third, there must be a means for the rapid suspension or abortion of the attack.

Thus far there has been little agreement on what requirements or conditions would be necessary for a framework of meaningful human control. While the phrase meaningful

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[94] Article 36, "Killer Robots: UK Government Policy on Fully Autonomous Weapons," *Article 36,* April 2013, http://www.article36.org/wp-content/uploads/2013/04/Policy_Paper1.pdf, p. 3-4.
[95] *Ibid.*
[96] *Ibid.*
[97] Frank Sauer, "ICRAC Statement on Technical Issues to the 2014 UN CCW Expert Meeting," *International Committee for Robot Arms Control*, July 9, 2014, http://icrac.net/2014/05/icrac-statement-on-technical-issues-to-the-un-ccw-expert-meeting/.

human control appears to have gained traction, at least in principle, with most parties at the UN CCW Meeting of Experts on LAWS, there have been concerns about the terminology. The U.S. delegation, supported by the Israeli delegation, has suggested that the terminology is subjective and that it is more appropriate to discuss "appropriate levels of human judgement" instead, which appears in DoD Directive 3000.09.[98] Article 36 itself even noted that "whilst this paper uses the term 'meaningful human control' there are other terms that refer to the same or similar concepts. These include 'significant', 'appropriate', 'proper', or 'necessary' 'human judgement' or 'human involvement'."[99]

Whatever one wishes to call it, it is important to reach at least a general working consensus on the issue of meaningful human control, before the discussion becomes bogged down solely on trying to define 'meaningful' or 'control'. Generally, most discussion over meaningful human control in LAWS centers around the need for a certain level of information to be available to human operators that allows them to make informed and meaningful decisions in an appropriate timeframe and that they are held accountable for their decisions. It may also be important to consider what exactly we envision there to be meaningful human control of, be it just the targeting and engagement phase or the entire system at large.[100] In that regard, discussing meaningful human control is somewhat different than consideration of an operator's place in regards to the 'loop,' as it is explicit in its emphasis on the quality of operator control and the responsibility for

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[98] "U.S. Delegation Opening Statement," p. 2.
[99] Article 36, "Key areas for debate on autonomous weapons systems," *Article 36,* May 2014, http://www.article36.org/wp-content/uploads/2014/05/A36-CCW-May-2014.pdf, p. 2.
[100] United Nations Institute for Disarmament Research, "The Weaponization of Increasingly Autonomous Technologies: Considering how Meaningful Human Control might move the discussion forward," *United Nations Institute for Disarmament Research,* accessed May 23, 2016, http://www.unidir.org/files/publications/pdfs/considering-how-meaningful-human-control-might-move-the-discussion-forward-en-615.pdf, p. 2.

their actions.[101] However one chooses to define meaningful human control, it is important to activists that the focus is maintained on ensuring that LAWS conform and comply with the laws of war and international humanitarian law.

There are at least two different viewpoints on the concept of meaningful human control and international humanitarian law.[102] The first, is that the laws of war adequately cover the development and use of LAWS and that the issue of meaningful human control is not a new, additional requirement, but instead ensures compliance with existing international humanitarian law.[103] The second, is that the existing laws of war are insufficient for LAWS and thus meaningful human control is a separate, additional requirement that LAWS must meet.[104] Regardless of viewpoint, there is general agreement that several aspects of international humanitarian law are challenged by LAWS and that these challenges must be addressed by some measure of meaningful human control.[105]

The concern of both viewpoints is to ensure that no "accountability gap" would exist that could create an ethical, moral, or legal gray area that would fail to assign responsibility to the actions of the commander and operator using LAWS or to the errors of the programmer and manufacturer who created the LAWS.[106] Roboticist Jai Galliott argues that despite claims of a potential accountability gap, "it would be preposterous to overlook the role of programmers, cognitive scientists, engineers and others involved in

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[101] *Ibid,* p. 3.
[102] "Meaningful Human Control in Weapon Systems: A Primer," p. 7-9.
[103] Kenneth Anderson, Daniel Resiner and Matthew Waxman, "Adapting the Law of Armed Conflict to Autonomous Weapon Systems," *International Law Studies* (90 Int'l L. Stud. 386), accessed May 23, 2016, https://www.usnwc.edu/getattachment/a2ce46e7-1c81-4956-a2f3-c8190837afa4/dapting-the-Law-of-Armed-Conflict-to-Autonomous-We.aspx, p. 410-411.
[104] "Losing Humanity: The Case Against Killer Robots."
[105] "Adapting the Law of Armed Conflict to Autonomous Weapon Systems," p. 387.
[106] "Autonomous Weapon Systems: Technical, Military, Legal and Humanitarian Aspects," p. 89.

building these autonomous systems. And even if we did, what of the commander, military force and government that made the decision to use the system?"[107] Jai Galliott contends that LAWS and those who create and use them, just as with traditional weapons systems and soldiers, would not suddenly somehow be beyond the prosecution of the law.[108] Yet ensuring accountability for the actions of LAWS continues to pose a serious challenge, one that will need to be met by meaningful human control and answered in how LAWS are programmed to comply with the laws of war and international humanitarian law.

Concerns Under International Humanitarian Law

In the ongoing debate over the issues before the UN CCW Meeting of Experts on LAWS, perhaps the most passionately argued case over a prohibition of LAWS is that by the human rights community. Activists have argued that LAWS would likely break international humanitarian law, violate human rights, and lead to even further dehumanization of war. These concerns cannot and should not be easily ignored or chided, as their importance brought initial attention to the issue of LAWS and continues to drive much of the international interest in the issue.

The most notable perceived challenges are to the *jus in bello* concepts of distinction and proportionality, though others such as military necessity and precautions in attack, can also be considered.[109] The general concern is that perceived technological limitations would not allow LAWS to be able to adhere to international law or that their

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[107] Jai Galliott, "Why We Should Welcome 'killer robots', Not Ban Them," *Phys.org*, July 30, 2015, http://phys.org/news/2015-07-killer-robots.html.
[108] *Ibid.*
[109] Kenneth Anderson and Matthew Waxman, "Law and Ethics for Autonomous Weapon Systems: Why a Ban Won't Work and How the Laws of War Can," *Hoover Institution,* April 9, 2013, http://www.hoover.org/sites/default/files/uploads/documents/Anderson-Waxman_LawAndEthics_r2_FINAL.pdf, p. 11.

adherence would not be at a comparable level to that of humans.[110] While the use of LAWS might be acceptable outright under international law in very situationally specific environments, such as areas with no civilians, little risk to civilians and civilian objects, or in purely machine v. machine operations, these circumstances would be markedly different from the current trend in warfare over the last several decades.[111] These concerns are drawn from several important historical and contemporary considerations regarding the conduct of war and international humanitarian law.

The first concern is that LAWS would not adhere to the concept of distinction, either of civilian and military targets or between combatants, persons *hors de combat*, and civilians.[112] There are four Articles under the Additional Protocol I to the Geneva Conventions that are the basis for the argument regarding LAWS and the concept of distinction: Article 41, Article 48, Article 50, and Article 52. Article 48 is the basis for the concept of distinction and states that: [113]

> In order to ensure respect for and protection of the civilian population and civilian objects, the Parties to the 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.

Article 52 offers protection to civilian objects and defines them by defining military objectives,[114] Article 50 defines civilians and civilian populations and includes the

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[110] Human Rights Watch, "Killer Robots and the Concept of Meaningful Human Control," *Human Rights Watch*, April 11, 2016, https://www.hrw.org/news/2016/04/11/killer-robots-and-concept-meaningful-human-control.
[111] "Losing Humanity: The Case Against Killer Robots."
[112] "Autonomous Weapon Systems: Technical, Military, Legal and Humanitarian Aspects," p. 77.
[113] International Committee of the Red Cross, "Article 48 – Basic Rule," *International Committee of the Red Cross,* accessed May 26, 2016, https://www.icrc.org/ihl/4e473c7bc8854f2ec12563f60039c738/8a9e7e14c63c7f30c12563cd0051dc5c?OpenDocument.
[114] International Committee of the Red Cross, "Article 52 – General Protection of Civilian Objects," *International Committee of the Red Cross,* accessed May 26, 2016,

concept of doubt,[115] and Article 41 prohibits attacks against persons *hors de combat* (outside the fight).[116] Adhering to the concept of distinction is one of the greatest challenges likely to face LAWS in adhering to international humanitarian law because distinction would require a qualitative, rather than quantitative, judgement.[117] Qualitative judgements would have to be preprogrammed across an incredibly huge range of factors, which would be extremely difficult under even the best of circumstances, but would also need to be able to determine certain abstract characteristics necessary to make a judgement based on distinction, such as intent and doubt.[118]

The second concern is that that LAWS could not adhere to the concept of proportionality, recognizing that certain engagement against military targets may incidentally affect civilians or civilian objects.[119] Article 51(5)(b) under the Additional Protocol I to the Geneva Conventions is the basis for the formulation of decisions based on proportionality, stating that "an attack 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." [120]

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https://www.icrc.org/applic/ihl/ihl.nsf/Article.xsp?action=openDocument&documentId=F08A9BC78AE360B3C12563CD0051DCD4.

[115] International Committee of the Red Cross, "Article 50 – Definition of Civilians and Civilian Population," *International Committee of the Red Cross,* accessed May 26, 2016, https://www.icrc.org/applic/ihl/ihl.nsf/Article.xsp?action=openDocument&documentId=E1F8F99C4C3F8FE4C12563CD0051DC8A.

[116] International Committee of the Red Cross, "Article 41 – Safeguard of an Enemy Hors de Combat," *International Committee of the Red Cross,* accessed May 26, 2016, https://www.icrc.org/applic/ihl/ihl.nsf/Article.xsp?action=openDocument&documentId=A792529AA66D8C56C12563CD0051DB5E.

[117] "Autonomous Weapon Systems: Technical, Military, Legal and Humanitarian Aspects," p. 77.

[118] "Losing Humanity: The Case Against Killer Robots."

[119] "Autonomous Weapon Systems: Technical, Military, Legal and Humanitarian Aspects," p. 82.

[120] International Committee of the Red Cross, "Article 51 – Protection of the Civilian Population," *International Committee of the Red Cross,* accessed May 26, 2016,

The concept of proportionality is another exceptionally difficult challenge likely to face LAWS because the concept requires a qualitative judgement on an entirely case-by-case basis, in a battlefield situation, of whether the loss to civilians would be too excessive in relation to the military advantages anticipated from the action.[121] Such decisions in the midst of an ongoing military operation depend heavily on the context of the decision in relation to the larger picture and are subjective, not objective, in value, which would require a near infinite number of scenarios to be preprogrammed.[122]

There are several other concerns regarding LAWS, such as the rule of precautions in attack and the principle of military necessity. The rule of precautions in attack is outlined in Article 57(2) under the Additional Protocol I to the Geneva Conventions and requires that constant evaluations must be made to spare civilians and civilians objects during the conduct of hostilities.[123] The principle of military necessity is closely related to proportionality, in that it "permits measures which are actually necessary to accomplish a legitimate military purpose and are not otherwise prohibited by international humanitarian law."[124] Adherence to the rule of precautions in attack pose several challenges to LAWS, such as a need to assess the feasibility of any precautions, verify the nature of the military objective, choose means and methods to avoid or minimize

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https://www.icrc.org/applic/ihl/ihl.nsf/Article.xsp?action=openDocument&documentId=4BEBD9920AE0AEAEC12563CD0051DC9E.

[121] *Ibid.*

[122] "Losing Humanity: The Case Against Killer Robots."

[123] International Committee of the Red Cross, "Article 57 – Protections in Attack," *International Committee of the Red Cross,* accessed May 26, 2016, https://www.icrc.org/applic/ihl/ihl.nsf/Article.xsp?action=openDocument&documentId=50FB5579FB098FAAC12563CD0051DD7C.

[124] International Committee of the Red Cross, "Military Necessity," *International Committee of the Red Cross*, accessed May 27, 2016, https://www.icrc.org/casebook/doc/glossary/military-necessity-glossary.htm.

incidental loss, and the obligation to suspend an attack.[125] Observance of the principle of military necessity would require LAWS to make subjective judgements about whether an engagement was a legitimate military purpose that would weaken the military capacity and capability of either an opposing combatant or that of the opposing party in armed conflict.[126] The concerns over the rule of precautions in attack and the principle of military necessity are no less important and no less difficult challenges for LAWS to overcome than that of distinction and proportionality.

LAWS are also considered to be a concern under the Martens Clause and other general human rights concepts, such as human dignity, the right to live, and the moral and ethical responsibility in the application of force, among other issues. The Martens Clause, outlined in Article 1(2) under the Additional Protocol I to the Geneva Conventions, states that ”in cases not covered by this Protocol or by other international agreements, civilians and combatants remain under the protection and authority of the principles of international law derived from established custom, from the principles of humanity and from the dictates of public conscience.” [127] The Martens Clause encompasses principles not found in the treaty by requiring that the means of warfare be held to a higher standard of examination according to the “principles of humanity” and “dictates of public conscience,” which would seem a truly difficult standard to surmount for LAWS because they are distinctly without the qualities that would allow them to relate to humans.[128] Concerns raised over the aforementioned ‘other general human rights concepts’ are an

[125] “Autonomous Weapon Systems: Technical, Military, Legal and Humanitarian Aspects,” p. 84-87.
[126] “Losing Humanity: The Case Against Killer Robots.”
[127] International Committee of the Red Cross, “Article 1 – General Principles and Scope of Application,” *International Committee of the Red Cross,* accessed May 26, 2016, https://www.icrc.org/ihl/WebART/470-750004.
[128] “Killer Robots and the Concept of Meaningful Human Control.”

extension of this argument, that machines cannot and should not be allowed to take human lives because it is an erosion of the concepts of humanity.[129]

While the debate continues on addressing these concerns, some opponents to a ban on LAWS see the systems as potentially benefiting international humanitarian law and the conduct of war, rather than violating it. The Heritage Foundation's Steven Groves has written that the U.S. should oppose attempts to force a ban on LAWS because DoD Directive 3000.09 mandates appropriate levels of human judgement be built into LAWS and that U.S. soldiers are required to follow the laws of armed conflict, which would extend to their use of LAWS.[130] He goes on to argue that as a nonexistent weapon, "there is no evidence that LAWS constitute *per se* violations of the principles of distinction and proportionality," and instead LAWS may "have the potential to increase U.S. effectiveness on the battlefield while decreasing collateral damage and loss of human life."[131] Kenneth Anderson and Matthew Waxman, like Groves, also espouse the "humanitarian risks to prohibition, given the possibility that autonomous weapons systems could in the long run be more discriminating and ethically preferable to alternatives."[132] This sentiment of ethical LAWS is echoed by roboticist Ronald Arkin, who argues that "the status quo is unacceptable with respect to noncombatant deaths. It may be possible to save noncombatant lives through the use of this technology—if done correctly—and these efforts should not be prematurely terminated by a preemptive

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[129] "Losing Humanity: The Case Against Killer Robots."
[130] Steven Groves, "The U.S. Should Oppose the U.N.'S Attempt to Ban Autonomous Weapons," *Heritage Foundation*, March 5, 2015, http://www.heritage.org/research/reports/2015/03/the-us-should-oppose-the-uns-attempt-to-ban-autonomous-weapons.
[131] *Ibid.*
[132] "Law and Ethics for Autonomous Weapon Systems: Why a Ban Won't Work and How the Laws of War Can," p. 21.

ban."[133] Author Ronald Bailey furthers this thought on the ethical use of LAWS, by noting that "since self-preservation would not be their foremost drive, they would refrain from firing in uncertain situations. Not burdened with emotions, autonomous weapons would avoid the moral snares of anger and frustration. They could objectively weigh information and avoid confirmation bias when making targeting and firing decisions."[134] Both proponents and opponents raise concerns regarding the applicability of international humanitarian law to LAWS and it is perhaps the most difficult concern to address by those developing the technology.

Chapter Summary

The issues that surround establishing common understanding on LAWS emphasized above, are the basis for much of the initial debate between proponents and opponents at the UN CCW Meeting of Experts on LAWS. In trying to reach some semblance of commonality, the importance of defining LAWS, autonomy, and meaningful human control is paramount in order to move forward on any meaningful efforts to ban LAWS. Yet the debate over exactly what systems are being addressed, how autonomy should be categorized, what issues are driving increased autonomy, the role of meaningful human control in those systems, and concerns over international law are all debates worth having. While these debates focus on systems that do not (and indeed may not ever) exist, they are based on and informed by their precursors, unmanned systems, and by previous attempts at international arms control.

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[133] Ronald Arkin, "The Case for Banning Killer Robots: Counterpoint," *Communications of the ACM*, December 1, 2015, http://cacm.acm.org/magazines/2015/12/194632-the-case-for-banning-killer-robots/fulltext#R8.
[134] Ronald Bailey, "Bring On the Killer Robots," *Newsweek*, February 01, 2015, http://www.newsweek.com/bring-killer-robots-303299.

BACKGROUND: UNMANNED SYSTEMS

Although the U.S. government treats LAWS and the current plethora of unmanned systems as wholly different systems, the development of LAWS has a grounded basis in the past, present, and future of unmanned systems.[135] The research in this chapter originated from a research project on unmanned systems conducted by the author for a Missouri State University class entitled *Regional Security in the Greater Middle East*, with portions of the original paper featured throughout. While the history of unmanned systems can perhaps be traced back several decades, it is only within the last decade or so that the systems have risen to an early level of prominence in warfare and, barring some radically new technological breakthrough, they are likely to continue to ascend in importance in the near future. As an early adopter of unmanned systems, the U.S. military has developed and deployed a wide range of unmanned systems across land, air, and sea operating domains to perform a variety of mission sets, some of which are lethal. There also exists a burgeoning international market for unmanned systems, particularly weaponized ones, which is helping drive the quest for greater levels of autonomy in unmanned systems. Although weaponized unmanned systems make up only a small portion of the U.S. military's unmanned system fleet, the public perception of 'drone strikes' and 'drone warfare' has colored domestic and international views of the role of unmanned systems in warfare. In the debates before the UN CCW Meeting of Experts on LAWS the perceptions held by many parties can perhaps be traced to their unique experience with unmanned systems.

[135] "U.S. Delegation Opening Statement," p.1.

Unmanned Systems Terminology

In order to expound on unmanned systems as the precursors to LAWS, it is important to first clarify exactly what is meant by unmanned systems and how they differ from manned systems. The U.S. National Institute of Standards and Technology defines an "unmanned system" as "a powered physical system, with no human operator aboard the principal components, which acts in the physical world to accomplish assigned tasks. It may be mobile or stationary. It can include any and all associated supporting components such as operator control units (OCU). Examples include unmanned ground vehicles (UGV), unmanned aerial vehicles/systems (UAV/UAS), unmanned maritime vehicles (UMV)--unmanned underwater vehicles (UUV) or unmanned water surface borne vehicles (USV)--unattended munitions (UM), and unattended ground sensors (UGS). Missiles, rockets, and their submunitions, and artillery are not considered the principal components of UMSs."[136] The National Institute of Standards and Technology definition is used by both the National Defense Industrial Association (NDIA) and the Office of the Undersecretary of Defense for Acquisition, Technology, and Logistics, and includes unattended munitions and ground sensors within its definition.

The U.S. Department of Defense's (DoD) *Unmanned Systems Integrated Roadmap* of both FY2011 and FY2013 also use the term "unmanned system," but do not define it, instead breaking it down into "unmanned aircraft systems," "unmanned ground systems," and "unmanned maritime systems," and then defining those.[137] The DoD

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[136] National Institute of Standards and Technology, "Autonomy Levels for Unmanned Systems (ALFUS) Framework, Volume I: Terminology," *National Institute of Standards and Technology* (Ver. 2.0, NIST Special Publication 1011-I-2.0), October 2008, http://www.nist.gov/el/isd/ks/upload/NISTSP_1011-I-2-0.pdf, p. 28.

[137] U.S. Department of Defense, "Unmanned Systems Integrated Roadmap FY2013-2038," *U.S. Department of Defense* (14-S-0553), accessed May 22, 2016, http://www.defense.gov/Portals/1/Documents/pubs/DoD-USRM-2013.pdf, p. 4, 6, 8.

Directive 3000.09 entitled *Autonomy in Weapon Systems* from the Office of the Undersecretary of Defense for Policy and signed by then Deputy Secretary of Defense Ash Carter, uses the term "unmanned platform" and defines it simply as "an air, land, surface, subsurface, or space platform that does not have the human operator physically onboard the platform."[138] The *Department of Defense Dictionary of Military and Associated Terms* does not include or define unmanned systems at all, instead only offering definitions for "unmanned aircraft" (UA) and "UAS."[139]

As an example, the lack of cohesive terminology on unmanned systems, even within DoD, is endemic of the larger problem with defining LAWS because the combination of terms using "unmanned" and "system" are used to describe both a vehicle and an entire system of vehicle, equipment, network, and personnel. Then there's the platform, which has long been a dubiously used term, one that could be used to denote a variety of meanings, including a single vehicle, a fleet of vehicles, or the system of vehicle, equipment, network, and personnel. For the purpose of this paper, we will use National Institute of Standards and Technology's definition for "unmanned systems," because it generally covers most of the factors that differentiate unmanned systems from traditional manned systems and covers the breakup among unmanned systems. We will also abbreviate unmanned vehicle(s) as (UxV) and unmanned system(s) as (UxS). This offers a terminology distinction between vehicles and systems, with UxV used to describe the actual vehicle; UxS to describe the system of vehicle, equipment, network, and personnel; and allows the 'x' to be replaced with the operating domain of the unmanned

[138] U.S. Department of Defense, "Autonomy in Weapon Systems," *U.S. Department of Defense* (Directive 3000.09), November 21, 2012, http://www.dtic.mil/whs/directives/corres/pdf/300009p.pdf, p. 15.
[139] U.S. Department of Defense, "Department of Defense Dictionary of Military and Associated Terms," *U.S. Department of Defense* (Joint Publication 1-02), February 15, 2016, http://www.dtic.mil/doctrine/new_pubs/jp1_02.pdf, p. 252.

vehicle or system.

In clarifying unmanned systems, it is important to differentiate them from both traditional manned vehicles and various iterations of smart weapons and munitions, in-order to recognize the qualitatively different challenges they pose. The obvious and key difference between an unmanned system and any traditional manned vehicle or system, is that an unmanned system does not physically have the operator onboard the vehicle, implying a lack of physical threat to the operator in operating the vehicle. Yet it can be somewhat difficult to the casual observer to define, for example, exactly what differences exist between an UAV and current 'smart' missile technology.[140] The primary differentiating factor, is simply that an UxV is designed to be reused or recovered, but that a smart munition is designed to be expendable.

While this factor generally holds true, there currently exists a bit of a grey area when an UxV is designed to be expendable, either because recovery is not desirable, possible, or intended, particularly for an UxV used to self-destruct on a target. The Israeli Orbiter 1K is a great example, in that it carries a 2.2kg warhead and can be used to self-destruct on impact with light vehicles, but is also used as a traditional ISR platform and can be recovered and reused should no suitable target be identified.[141] The Orbiter 1K and other systems like it are usually considered loitering munitions, but act quite similarly to UAVs, which only serves to muddy the waters further to the casual observer. The use of the NIST's definition allows us to skirt the argument of reusability because it does not include the factor at all. The NIST definition also clearly states that “missiles, rockets,

[140]John Keller, “Should Some Smart Munitions Be Classified as Unmanned Aerial Vehicles (UAVs),” *Military & Aerospace Electronics*, March 24, 2015, http://www.militaryaerospace.com/articles/2015/03/smart-munition-blog.html.
[141]Noam Eshel, “A Mini UAV Becomes a Suicide Drone,” *Aviation Week Network*, June 16, 2015, http://aviationweek.com/paris-air-show-2015/mini-uav-becomes-suicide-drone-0.

and their submunitions, and artillery are not considered unmanned systems."[142] While the decision to not include these munitions within the NIST definition is not well defined, it is likely an argument of reuse.

While we will consider unattended munitions to some extent, there is relatively little benefit in pursuing a line on unattended ground sensors in discussing LAWS. Unattended ground sensors can be generally defined as a system encompassing a variety of interconnected sensing devices that may utilize seismic, acoustic, magnetic, pyroelectric, or imaging sensors to autonomously detect and report on presence or movement in a specific area.[143] By definition, there is no reason to utilize unattended ground sensors in our discussion because they distinctly lack a weapon as part of the system, lethal or not. Unfortunately, unattended munition is a difficult term to work with because there exists no real definition for what exactly it encompasses. Unattended munitions can be generally defined as a munition that is designed to be unaccompanied or not be watched, but there is scarce little more to go on.[144] As such, there will be scant discussion on unattended munitions in this chapter.

Next, we must tackle what terms and differences exist between the wide array of unmanned systems. UxV and UxS are typically defined along lines based on the operating domains of aerial, ground, maritime, and space, but can also be broken down based on vehicle type, position within the operating domain, maneuverability, and level of autonomy.

In the aerial operating domain, the most commonly used term is the UAV which is defined by the DoD as a "powered, aerial vehicles that do not carry a human operator, use

[142] "Autonomy Levels for Unmanned Systems (ALFUS) Framework, Volume I: Terminology," p. 28.
[143] *Ibid.*
[144] *Ibid.*

aerodynamic forces to provide vehicle lift, can fly autonomously or be piloted remotely, can be expendable or recoverable, and can carry a lethal or nonlethal payload. Ballistic or semi ballistic vehicles, cruise missiles, and artillery projectiles are not considered unmanned aerial vehicles."[145] More recently the U.S. government (and by extension the DoD) has moved to use the terms UA and UAS as originally laid out in the DoD *Unmanned Aircraft Systems Roadmap 2005-2030*.[146] The roadmap definitions are used in the *DoD Dictionary of Military and Associated Terms*, which defines an "unmanned aircraft" as "an aircraft that does not carry a human operator and is capable of flight with or without human remote control," and an "unmanned aircraft system" as "that system whose components include the necessary equipment, network, and personnel to control an unmanned aircraft."[147] While UA and UAS have become an accepted standard to replace UAV across both the DoD and the whole of the U.S. government, the paper will use all three terms and definitions (UAV, UA, and UAS) in discussion of unmanned systems in the aerial operating domain.

For the ground operating domain, the term "unmanned ground vehicle" (UGV) is frequently used, which is defined by the DoD as "a powered, mobile, ground conveyance that does not have a human aboard; it can be operated in one or more modes of control (autonomous, semiautonomous, teleoperation, remote control); it can be expendable or recoverable; and it can have lethal or non-lethal mission modules."[148] More recently the DoD has begun using the term "unmanned ground system" (UGS), which is defined in

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[145] U.S. Department of Defense, "Unmanned Aircraft Systems Roadmap 2005-2030," *U.S. Department of Defense*, accessed May 22, 2016, https://fas.org/irp/program/collect/uav_roadmap2005.pdf, p. 1.
[146] *Ibid.*
[147] "Department of Defense Dictionary of Military and Associated Terms," p. 252.
[148] U.S. Department of Defense, "Unmanned Systems Safety Guide for DoD Acquisition," *U.S. Department of Defense* (1st Ed., Ver. .96), January 2007, https://www.ndia.org/Divisions/Divisions/Robotics/Documents/Content/ContentGroups/Divisions1/Robotics/UMS_SafetyPolicyVer096_Released.pdf, p. 49.

the *Unmanned Systems Integrated Roadmap FY2013-2038* as "a powered physical system with (optionally) no human operator aboard the principal platform, which can act remotely to accomplish assigned tasks. UGS may be mobile or stationary, can be smart learning and self-adaptive, and include all associated supporting components such as operator control units."[149] With both UGV and UGS being the standard terms used in the DoD, the paper will use the terms and definitions in discussion of unmanned systems in the ground operating domain.

In the maritime operating domain, there are two types of UxV, USV and UUV, which are part of an "unmanned maritime system" (UMS). The DoD defines both USV and UUV in the *Unmanned Systems Integrated Roadmap FY2011-2036*, defining USV as vehicles "that operate with near-continuous contact with the surface of the water, including conventional hull crafts, hydrofoils, and semi-submersibles" and UUV as vehicles "made to operate without necessary contact with the surface (but may need to be near surface for communications purposes) and some can operate covertly."[150] The DoD goes on to define UMS as "unmanned vehicles that displace water at rest," but also that it comprises "all necessary support components, and the fully integrated sensors and payloads necessary to accomplish the required missions."[151] For the purpose of the paper, we will use the terms and definitions for USV, UUV, and UMS, in our discussion of unmanned systems in the maritime operating domain.

In regards to the space operating domain, there has been no shortage of the use of

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[149] "Unmanned Systems Integrated Roadmap FY2013-2038," p. 6.
[150] U.S. Department of Defense, "Unmanned Systems Integrated Roadmap FY2011-2036," *U.S. Department of Defense* (11-S-3613), accessed May 22, 2016, http://www.acq.osd.mil/sts/docs/Unmanned%20Systems%20Integrated%20Roadmap%20FY2011-2036.pdf, p. 25.
[151] "Unmanned Systems Integrated Roadmap FY2013-2038," p. 8.

unmanned spacecraft within the domain and they can be simply defined as a vehicle or machine without a human operator on-board designed to achieve spaceflight. The Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies (Outer Space Treaty) is regarded as the basic legal framework for international actions in space and while it precludes the deployment of weapons of mass destruction in space, it does not ban conventional weapons, which has been a subject of debate among both spacefaring and non-spacefaring nations.[152] While there exists a rapidly increasing number and variety of unmanned spacecraft in various levels of space, there are currently no known weapons within space or within Earth's orbit, though it remains quite technically feasible. Because the focus of this paper is on LAWS, it is difficult to discuss at great length on an operating domain that does not currently have weaponized unmanned systems within it, though it is certainly possible that they may one day exist.

Finally, regarding the popularly used term "drone," the term was originally a nickname given by troops training against unmanned aerial targets in World War II because of the 'droning' sound that the target aircraft engines made when they flew by at a controlled constant speed.[153] Over the years the nickname has become something of a popular, albeit overly simplified, catchall term, that is synonymously used for unmanned vehicles across every operating domain, weaponized or not. While the term drone may often be used synonymously for unmanned systems within the popular lexicon, the term should not be considered synonymous with LAWS because of the distinct differences

[152]Nuclear Threat Initiative, "Proposed Prevention of an Arms Race in Space (PAROS) Treaty," *Nuclear Threat Initiative*, accessed May 22, 2016, http://www.nti.org/learn/treaties-and-regimes/proposed-prevention-arms-race-space-paros-treaty/.
[153]Kelsey D Atherton, "The History of the Drone in 9 Minutes [Video]," *Popular Science*, November 24, 2014, http://www.popsci.com/watch-brief-history-drone.

over autonomy.

A Brief History of Unmanned Systems

In order for us to address the current state of unmanned systems and the implications of their use in warfare, we must briefly discuss the history of unmanned systems (particularly U.S. development) to grasp the extent of their evolution in a relatively short period of time, which amplifies the concerns over LAWS. It is difficult to pin down exactly when or what the earliest example of an unmanned system would be, weaponized or not. If we are to use the NIST definition of unmanned systems as our baseline, that means that an unmanned system would need to be "a powered physical system, with no human operator aboard the principal components, which acts in the physical world to accomplish assigned tasks," that could "be mobile or stationary."[154] We must also be mindful of the categories included in the NIST's definition and those systems and categories specifically not considered unmanned systems, namely "missiles, rockets, and their sub-munitions, and artillery."[155]

The first requisite, that an unmanned system be a powered system, precludes any potential unmanned systems that predates the use of electromechanical systems. Although various forms of automata had been designed and built over the centuries in Europe and Asia, they were not electromechanical systems, which only began to appear in increasing number during the 19th century. Some historians point to the use of unmanned hot-air balloons loaded with small bombs by the Austrians against Venice in 1849 and to patents filed in the U.S. for similar devices during the 1860s, as the earliest possible weaponized

[154] "Autonomy Levels for Unmanned Systems (ALFUS) Framework, Volume I: Terminology," p. 28.
[155] *Ibid.*

unmanned systems.[156] Still others point to advancements made in remotely controlled torpedoes and boats, such as the Brennan torpedo and Nikola Tesla's wireless boat, as a potential starting point. The problem with these suggestions and others like them, is that it is difficult to discern whether these potential early unmanned systems actually meet all (or indeed any) of the metrics in the NIST definition. Indeed, most of the early systems suggested are more accurately defined in the systems specifically not considered unmanned systems.

It is more generally accepted that some of what could be considered early unmanned systems were invented during World War I, particularly weaponized ones. Inventions like the American Kettering Bug, the German FL-Boat, and the American Wickersham Land Torpedo, could be considered some of the earliest unmanned systems that might meet the criteria of the NIST definition, yet these inventions are also difficult to accept wholly in relation to our definition. The Kettering Bug, was a biplane with most of the body replaced by explosives that flew to its target based on a mechanical system that would count engine revolutions before dropping out of the sky, which had more in common with and is considered a forerunner of the modern cruise missile.[157] The Germans produced a series of remotely controlled boats laden with explosives called the FL-Boat (Fernlenkboot), which managed at least one confirmed hit (the HMS Erebus) during the war, but arguably had as much in common with a traditional torpedo as an unmanned system.[158] The Wickersham Land Torpedo, a small tracked vehicle strapped

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[156]Russell Naughton, "Remote Piloted Aerial Vehicles," *Monash University*, February 02, 2003, http://www.ctie.monash.edu/hargrave/rpav_home.html#Beginnings.
[157]Jimmy Stamp, "Unmanned Drones Have Been Around Since World War I," *Smithsonian*, February 12, 2013, http://www.smithsonianmag.com/arts-culture/unmanned-drones-have-been-around-since-world-war-i-16055939/?no-ist.
[158] Wilson Rothman, "Unmanned Warbots of WWI and WWII," *Gizmodo*, March 24, 2009, http://gizmodo.com/5181576/unmanned-warbots-of-wwi-and-wwii.

with explosives and remotely controlled, was never even produced, which greatly diminishes its potential impact on unmanned systems.[159] While these inventions may also be somewhat difficult to determine whether they meet all of the requisites laid out in the NIST definition or not, they definitely served as grounds for the further development of unmanned systems.

During the interwar period limited experimentation with early unmanned systems continued, with both the British and American navies testing the use of radio controlled airplanes as targets for ship defense batteries with relative success in limited numbers.[160] The U.S. Naval Research Laboratory managed to fly a radio controlled Curtis F-5L through all phases of flight in 1924 and in 1935 the British began converting de Havilland Tiger Moth biplanes into radio controlled targets known as Queen Bees.[161] However it was the advent of World War II that fueled renewed interest in unmanned systems, as both sides sought wonder weapons to help get a leg up in the conflict.

The U.S. Army Air Forces and Navy experimented with the aerial torpedo concept by way of radio controlled bombers loaded with explosives in the unsuccessful Operations Aphrodite and Anvil.[162] The operations ground to a halt after they claimed the lives of several crews in accidents during early tests, most notable being pilot Joseph P. Kennedy Jr., elder brother of future U.S. President John F. Kennedy. During the 1930s and early 1940s the USSR developed and deployed Teletanks, mostly T-26s armed with flamethrowers modified for remote control, in the Winter War and the early phase of

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[159] *Ibid.*
[160] John F. Keane and Stephen S. Carr, "A Brief History of Early Unmanned Aircraft," *Johns Hopkins APL Technical Digest,* Vol. 32, No. 3 (2013), accessed May 22, 2016, http://www.jhuapl.edu/techdigest/TD/td3203/32_03-Keane.pdf, p. 561-564.
[161] *Ibid,* p. 561-563.
[162] *Ibid,* p. 565-566.

Operation Barbarossa in limited numbers.[163] The Radioplane OQ-2 became the first mass-produced unmanned system, with both the U.S. Army and Navy purchasing some 15,000 of the radio controlled target planes for training antiaircraft gunners.[164] Beginning in 1942 the Germans deployed several thousand Goliath tracked mines, a foot-tall remote controlled ground vehicle loaded with explosives designed to demolish enemy armor and structures, that was considered an operational failure due to high cost, poor operating capability, and susceptibility to a wide range of countermeasures.[165] Although the German V-weapons (Vergeltungswaffen) are not considered unmanned systems because of their status as missiles, it is undeniable that the lessons learned in their development played a role in the development of unmanned systems in the early years of the Cold War.

Development of unmanned systems continued during the early years of the Cold War, primarily to address the issue of accessibility for manned systems in 'undesirable' locations. During the late 1940s and early 1950s the U.S. Air Force flew radio controlled B-17s into the mushroom clouds of nuclear detonations to collect data on radioactivity.[166] In the 1960s and 1970s the Air Force also converted one of the most widely used unmanned targets, the jet-propelled Ryan Firebee, into an unmanned reconnaissance aircraft called the Lightning Bug, which were used during the Vietnam War to overfly areas considered too hostile for manned aircraft and then recovered when they parachuted

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[163] Erik Sofge, "Tale of the Teletank: The Brief Rise and Long Fall of Russia's Military Robots," *Popular Science*, March 07, 2014, http://www.popsci.com/blog-network/zero-moment/tale-teletank-brief-rise-and-long-fall-russia%E2%80%99s-military-robots.
[164] "Radioplane OQ-2 - Development and Operational History, Performance Specifications and Picture Gallery," *Military Factory*, accessed May 26, 2016, http://www.militaryfactory.com/aircraft/detail.asp?aircraft_id=331.
[165] Jon Guttman, "Goliath Tracked Mine: The Beetle That Started the ROV Craze," *HistoryNet*, May 5, 2011, http://www.historynet.com/goliath-tracked-mine-the-beetle-that-started-the-rov-craze.htm.
[166] Mark Wolverton, "Into the Mushroom Cloud," *Air & Space*, August 2009, http://www.airspacemag.com/history-of-flight/into-the-mushroom-cloud-35152524/?no-ist.

back to earth.[167] During the early 1960s the U.S. Navy purchased several hundred Gyrodyne QH-50 Drone Anti-Submarine Helicopters (known as DASH) to provide anti-sub capabilities on ships too small for regular helicopters to operate from.[168] Around the same time period UUVs, either remotely piloted or autonomous in nature, were experimented with and developed by both government and private organizations to study the ocean (University of Washington's SPURV)[169] and facilitate undersea recovery (U.S. Navy's CURV).[170] Development of UGVs was limited during the Cold War, largely due to a lack of military interest, with most systems largely relegated to laboratory testing like the U.S. Defense Advanced Research Projects Agency's (DARPA) Shakey the Robot and Autonomous Land Vehicle project.[171]

While the U.S. was not the only country to develop and deploy unmanned systems during this time period of the Cold War, there is unfortunately less readily available data on other countries' attempts at unmanned systems. The USSR developed and deployed (though it is unknown if they were ever used) several jet-propelled unmanned reconnaissance aircraft between the 1960s-1980s, such as the Tupolev Tu-123, Tu-141, and Tu-143, that operated much like the U.S. Air Force Lightning Bee and the cancelled Lockheed D-21.[172] The People's Republic of China is thought to have reverse

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[167] "A Brief History of Early Unmanned Aircraft," p. 567-568.
[168] *Ibid,* p. 567.
[169] "Special Purpose Underwater Research Vehicle (SPURV)," *Naval Drones*, accessed May 22, 2016, http://www.navaldrones.com/SPURV.html.
[170]SPAWAR Systems Center Pacific, "Cable-Controlled Underwater Recovery Vehicle (CURV)," *SPAWAR Systems Center Pacific*, accessed May 22, 2016, http://www.public.navy.mil/spawar/Pacific/Robotics/Pages/CURV.aspx.
[171] Douglas W. Gage, "UGV HISTORY 101: A Brief History of Unmanned Ground Vehicle (UGV) Development Efforts," *Unmanned Systems Magazine,* Vol. 13, No. 3 (Summer 1995), accessed May 22, 2016, http://citeseerx.ist.psu.edu/viewdoc/download;jsessionid=881C89DDD940FD2FF3956EC7B7AAA477?doi=10.1.1.41.7062&rep=rep1&type=pdf, p. 2-3.
[172] Robert Beckhusen, "Ukraine Resurrects Soviet-Era Super Drones," *War Is Boring*, June 5, 2014, https://warisboring.com/ukraine-resurrects-soviet-era-super-drones-3403f80c51ba#.jj7f7q9k2.

engineered the USSR's Lavochkin LA-17 target aircraft to produce its own Nanjing CK-1 target aircraft in the 1960s.[173]

Although the U.S., USSR, and PRC would continue the development of unmanned systems during the 1970s and early 1980s, it is the Israeli experience with UAVs that led to a revival of interest in and helped define the modern use of unmanned systems in warfare. The Israeli heavy loss of aircraft to Egyptian Soviet supplied advanced anti-air systems during the War of Attrition led the Israeli government to consider the use of unmanned systems in the early 1970s. During the Yom Kippur War in 1973, the Israelis launched numerous Northrop BQM-74 Chukar aerial targets at Syrian anti-air batteries in the Golan Heights, causing the Syrians to think an airstrike was underway and fire upon the Chukars, revealing their position and depleting their ammunition.[174] The Israelis also launched several Ryan Firebees modified for reconnaissance on flights over the Sinai, that despite heavy losses, were considered successful.[175] These successes in the Yom Kippur War and the desire for 'over-the-hill' reconnaissance led to the development of the Tadiran Mastiff, considered the first modern surveillance UAV, which combined a live video feed and loitering capability over a target area for an extended period of time.[176] Israeli use of UAVs during the 1982 Lebanon War led to the spotting and neutralization of Syrian anti-air positions and manned aircraft without the loss of a single Israeli manned aircraft, dramatically changing military

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[173] GlobalSecurity.org, "Chang Kong (CK-1)," *GlobalSecurity.org*, November 2007, http://www.globalsecurity.org/military/world/china/ck-1.htm.
[174] Israeli Air Force, "The Israeli Air Force," *Israeli Air Force*, accessed May 22, 2016, http://www.iaf.org.il/4968-33518-en/IAF.aspx.
[175] *Ibid.*
[176] "Tadiran Mastiff - Development and Operational History, Performance Specifications and Picture Gallery," *Military Factory*, accessed May 22, 2016, http://www.militaryfactory.com/aircraft/detail.asp?aircraft_id=901.

perceptions of unmanned systems from R&D novelty to potential battlefield mainstay.[177]

In the 1980s and 1990s technologies applicable to unmanned systems began to mature, allowing new and more robust systems to be developed and deployed in battlefield situations. In the mid-1980s the U.S. Navy and Army procured several Israeli AAI RQ-2 Pioneers to test the capability of commanders having access to real-time spotting to direct and assess target damage from ship batteries.[178] The Pioneers allowed the U.S. Navy to have at least one UAV airborne throughout the entirety of operations in the Persian Gulf War, one of which the Iraqi defenders of Faylaka Island near Kuwait City attempted to surrender to, fearing an imminent artillery barrage.[179] The success of the Pioneers and the efforts of joint CIA-Pentagon development projects led to the production of the iconic General Atomics MQ-1 Predator, which first saw use with NATO forces in the Yugoslav Wars in the mid-1990s.[180]

The early 2000s and the War on Terror brought a sharp increase in the variety and number of UAVs used by the U.S. military, with UAVs being allocated for intelligence, surveillance, and reconnaissance (ISR) missions at the strategic (RQ-4 Global Hawk), operational (MQ-1 Predator), and tactical (RQ-11 Raven) levels.[181] The War on Terror also led to the development of armed UAVs, with the first credited kill taking place in October of 2001, ushering in the highly controversial tactics of "drone warfare" that have occupied the discourse on unmanned systems ever since.[182] During the early 2000s

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[177] Charles Levinson, "Israeli Robots Remake Battlefield," *The Wall Street Journal*, January 13, 2010, http://www.wsj.com/articles/SB126325146524725387.
[178] "A Brief History of Early Unmanned Aircraft," p. 569.
[179] *Ibid.* 91-94
[180] John David Blom, "Unmanned Aerial Systems: A Historical Perspective," *Combat Studies Institute Press* (Occasional Paper 37), accessed May 22, 2016, http://usacac.army.mil/cac2/cgsc/carl/download/csipubs/OP37.pdf, p. 91-94.
[181] *Ibid,* p. 106.
[182] "The Story Behind America's First Drone Strike."

military development of UGVs, UUVs, and USVs lagged behind development and deployment of UAVs, though some systems saw success. The War on Terror led to further development of UGVs like the Foster-Miller TALON for use in both Iraq and Afghanistan for explosive ordnance disposal (EOD) and infantry reconnaissance.[183] At the same time, USVs like the Israeli Rafael Protector[184] and U.S. Navy's Common Unmanned Surface Vessel (CUSV) [185] saw limited testing and deployment for force protection, ISR, and mine warfare operations. The cancelled overly ambitious U.S. Army Future Combat Systems modernization program of 2003-2009 included a range of UAVs and UGVs, along with loitering munitions and non-line-of-sight munitions.[186] Today, development of unmanned systems is continuing at a rapid pace, with an ever increasing number of nation-states and non-state actors gaining access to and developing a wide array of unmanned systems.

The U.S. Unmanned Fleet

The U.S. government is thought to currently possess the largest inventory of unmanned systems in the world and is an undisputed leader in research, development, and deployment of new unmanned systems. Within the U.S. government the military owns the lion's share of unmanned systems and is the primary driver of research and development into new unmanned systems, which is reflected in the historical

[183] "TALON Tracked Military Robot," *Army Technology*, accessed May 22, 2016, http://www.army-technology.com/projects/talon-tracked-military-robot/.
[184] Mike Hanlon, "The Protector Unmanned Surface Vehicle (USV)," *GizMag*, August 16, 2006, http://www.gizmag.com/go/6023/.
[185] Noah Shachtman, "Navy Plots Unmanned, Heavily Armed Fleet," *Wired*, October 9, 2007, https://www.wired.com/2007/10/navy-plots-unma/.
[186] GlobalSecurity.org, "Future Combat Systems (FCS) / Future Combat System (FCS)," *GlobalSecurity.org*, accessed May 22, 2016, http://www.globalsecurity.org/military/systems/ground/fcs.htm.

development of American unmanned systems. While the total number of unmanned systems within the U.S. military's arsenal is unknown, there is estimated to be at least 10,000 UAVs,[187] some 7,000 UGSs, [188] along with what are likely between several dozens to a couple hundred UUVs and USVs in various stages of research, development, or deployment.

Data from the U.S. DoD describes the military's funding of unmanned systems across the enterprise from the 2014 Presidential Budget (PB14) by fiscal year, domain, and funding need (Table 1). Broken down along fiscal years, the amount of funding for unmanned systems in Table 1 peaked at $5.27 billion in FY2015 followed by a drop in overall funding to $4.92 billion in FY2016 and a partial recovery in FY2017 and FY2018 to $4.7 billion and $4.86 billion respectively. While UAVs are set to receive the bulk of funding outlined in Table 1, to the total tune of $21.7 billion from FY2014 – FY2018, there is also a substantial increase in yearly funding for UGVs (from $13 million in FY2014 to $66 million in FY2018) and UUVs and USVs (from $330.2 million in FY2014 to $381.8 million in FY2018). Unmanned system funding in Table 1 is split among the funding needs of research, development, test and evaluation (RDTE), procurement (Proc), and operations and maintenance (OM), fluctuating depending on the fiscal year and domain of the system. Generally speaking, most of the funding in Table 1 for unmanned systems from FY2014 – FY2018 is to be spent on procurement (total of $10.25 billion) over RDTE and OM, but for UUVs and USVs the OM funding ($900.2 million) is actually greater than the procurement funding ($708.2 million). It is important

[187] "Unmanned Systems Integrated Roadmap FY2013-2038," p. 5.
[188] Jeffrey L. Caton, "Autonomous Weapon Systems: A Brief Survey of Developmental, Operational, Legal, and Ethical Issues," *Strategic Studies Institute*, December 2015, http://www.strategicstudiesinstitute.army.mil/pubs/display.cfm?pubID=1309, p. 11.

to remember that the roughly $4-6 billion yearly funding for unmanned systems as outlined in PB14 is a small part of the larger defense budget, $525 billion in FY2014 and $577 billion in FY2018 respectively.[189]

Table 1. DoD unmanned systems funding ($ mil/PB14).[190]

Domain	FYDP	2014	2015	2016	2017	2018	Total
Air	RDTE	1189.4	1674.0	1521.4	1189.4	1087.9	6662.2
	Proc	1505.5	2010.2	1843.5	1870.7	2152.8	9382.7
	OM	1080.9	1135.2	1102.7	1156.9	1178.5	5654.1
Domain Total		3775.9	4819.4	4467.6	4217.0	4419.3	21699.1
Ground	RDTE	6.5	19.1	13.6	11.1	10.3	60.9
	Proc	6.5	27.9	30.7	42.6	55.4	163.1
	OM[1]	0.0	0.0	0.0	0.0	0.0	0.0
Domain Total		13.0	47.0	44.3	53.7	66.0	223.9
Maritime	RDTE	62.8	54.8	66.1	81.0	87.2	351.9
	Proc	104.0	184.8	160.1	158.1	101.1	708.2
	OM	163.4	170.3	182.4	190.5	193.6	900.2
Domain Total		330.2	409.8	408.6	429.7	381.8	1960.2
All	RDTE	1258.7	1747.9	1601.1	1281.5	1185.7	7075.0
	Proc	1616.0	2222.9	2034.3	2071.4	2309.3	10253.9
	OM	1244.3	1305.4	1285.1	1347.4	1372.1	6554.3
All Domains Total		4119.1	5276.2	4920.5	4700.4	4867.1	23883.2

[1] Ground OM is funded with overseas contingency operations funding.

[189] Chris Mailey, "US Department of Defense 2014 Budget Analysis," *Hampton Roads Chapter of AUVSI*, December 09, 2013, http://www.auvsi.org/hamptonroads/blogs/chris-mailey/2013/09/12/us-department-of-defense-2014-budget-analysis.
[190] "Unmanned Systems Integrated Roadmap FY2013-2038," p. 3.

As the largest type of unmanned systems in the U.S. military, UAVs and UAS incorporate an increasingly larger number and variety of systems across all branches. Because of the diffuse use of UAVs and the unique requirements required by each of the service branches, the DoD moved in 2010 to a "group system" for standardizing categorization of UAVs and UAS across the military enterprise.[191] The UAS group system has five groups, with each group separated by maximum takeoff weight, normal operating altitude, and airspeed (Table 2). As noted in Table 2, the size, maximum takeoff weight, and normal operating altitude of a UAV typically increases as you move from Group 1 on the low end to Group 5 on the high end, while airspeed stops as an increasing categorical requirement at Group 3.

Table 2. DoD UAS Group System.[192]

UAS Group	Maximum Weight (lbs.)	Normal Operating Altitude (ft.)	Airspeed (kts)
Group 1	0-20	< 1,200	100
Group 2	21-55	< 3,500	< 250
Group 3	< 1,320	< 18,000	< 250
Group 4	> 1,320	< 18,000	Any Airspeed
Group 5	> 1,320	> 18,000	Any Airspeed

The DoD *Unmanned Systems Integrated Roadmap FY2013-2038* lists the number and type of UAV/UAS in the U.S. military (as of July 1, 2013) by UAS group and also

[191] U.S. Department of Defense, "Unmanned Aircraft System Airspace Integration Plan," *U.S. Department of Defense* (Ver. 2.0, 1-7ABA52E), March 2011, http://www.acq.osd.mil/sts/docs/DoD_UAS_Airspace_Integ_Plan_v2_%28signed%29.pdf, p. D-3.
[192] *Ibid.*

denotes what services are flying which systems (Figure 1). UAS Group 1 in Figure 1 contains the majority of UAVs owned by the DoD (nearly 9,800), which are used by multiple services and are solely ISR UAVs. The group includes the RQ-11 Raven, WASP, Puma, and RQ-16 T-Hawk, which are typically considered hand-launched tactical UAVs used to support platoon level or smaller groups. There is only one UAV listed in UAS Group 2 in Figure 1, the ScanEagle, which is used by the Navy and Marine Corps and is a larger, catapult launched ISR system. UAS Group 3 in Figure 1 lists three UAVs, the RQ-7 Shadow, an expeditionary UAS (the cancelled A160 Hummingbird), and a small tactical UAS (RQ-21 Blackjack), which are catapult launched (except for the A160) ISR UAVs. UAS Group 4 in Figure 1 begins a substantial departure from previous groups, containing three UAVs, the MQ-1 Predator, MQ-9 Hunter, and MQ-8 Fire Scout. The UAVs in UAS Group 4 require a runway or cleared landing zone and can carry a suite of ISR sensors and kinetic armaments. The two UAVs in UAS Group 5 in Figure 1 are the MQ-9 Reaper and the RQ-4 Global Hawk, one a multi-role hunter-killer and the other a dedicated high-altitude ISR system, which require devoted runways for takeoff.

The roadmap also lists current DoD deployment of UGV/UGS and the expectation of future development across the enterprise, defined by the mission or capability area that the system is intended to address (Figure 2). The systems exampled in Figure 2 make up the bulk of UGV in use by the U.S. military today, but also showcases the intended direction of near-term future capabilities that are being pursued to support the warfighter. Several of the systems listed are not new unmanned systems, but rather unmanned or automation capabilities being given to existing ground vehicle platforms. The ‘protection’ mission encompasses the capability areas of EOD, CBRN, protection,

and engineering, whose systems include current and follow-on procurements like the Foster-Miller TALON, the M160 Light Flail mine clearer, and the Husky Mounted Detection System. The 'sustainment' mission includes the capability areas of logistics and transport, which includes unmanned capability for the HMMWV and its replacement the JLTV, the FMTV series of transport vehicles, and the HMEE armored backhoe. The 'soldier' mission contains the capability areas of ISR and command and control, that includes throwable UGVs like the FirstLook and Recon Scout and an interoperable universal controller for UGVs.

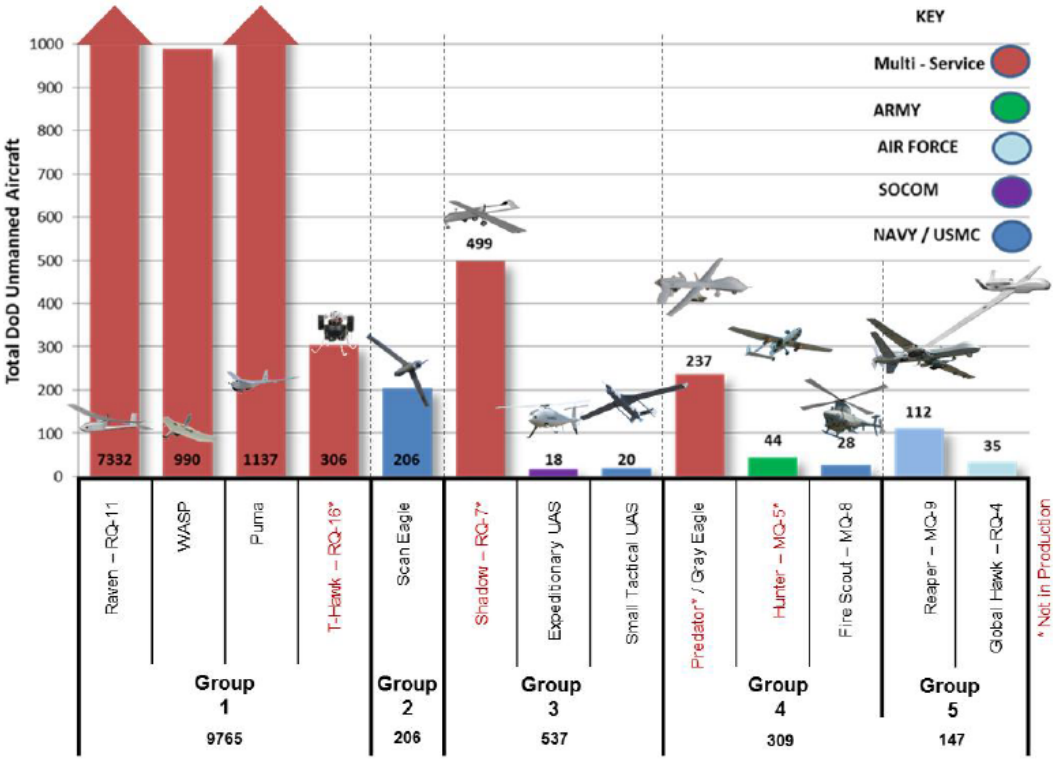

Figure 1. Inventory of DoD UAS.[193]

[193] "Unmanned Systems Integrated Roadmap FY2013-2038," p. 5.

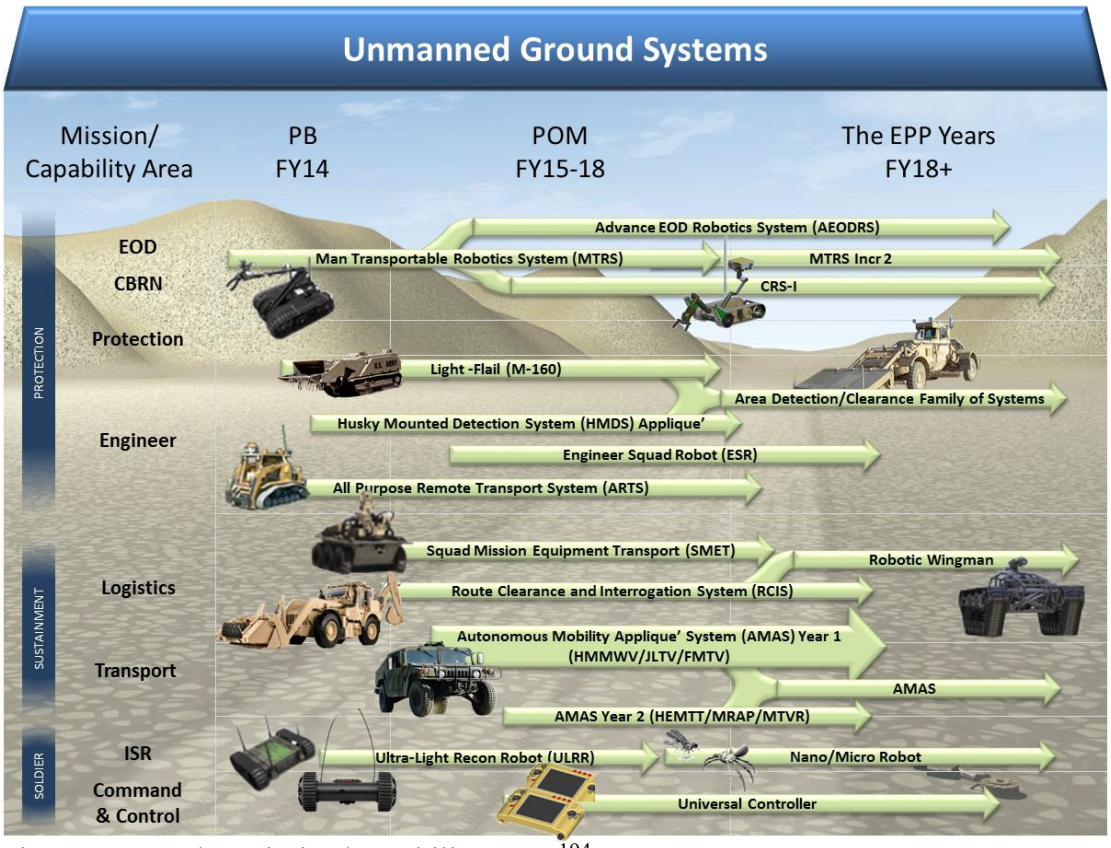

Figure 2. UGS by Mission/Capability Area.[194]

Additionally, the roadmap lists several USVs and UUVs undergoing development and deployment, that are defined by mission area and operating domain (Figure 3). The current development and deployment of USVs and UUVs as demonstrated in Figure 3, tend to focus on mine counter-measure and maritime security support to the Navy, with some systems (particularly UUVs) dipping into both mission areas. The mine counter-measure and maritime security vessels referenced in Figure 3, such as the mine countermeasure USV (the U.S. Navy's Common Unmanned Surface Vessel), the U.S. Naval Postgraduate School's Sea Fox Mk I and II, and the Modular Unmanned Surface Craft Littoral, are small craft that operate in the riverine or littoral zones in support of littoral combat ships (LCS), with fewer than a dozen total having been produced. Most of

[194] *Ibid,* p. 7.

the UUVs in Figure 3 are proof of concept (Pennsylvania State University's Sea Stalker and Sea Maverick) or near-term future systems, though some are in use in limited numbers today, such as the Remote Mine-Hunting System and the MK18 Mod 1 Swordfish and Mod 2 Kingfish. The dearth of operational UUVs is largely due to the lack of reliable navigation and communication capabilities, which is a problem that has plagued development and deployment of UUVs for decades.[195]

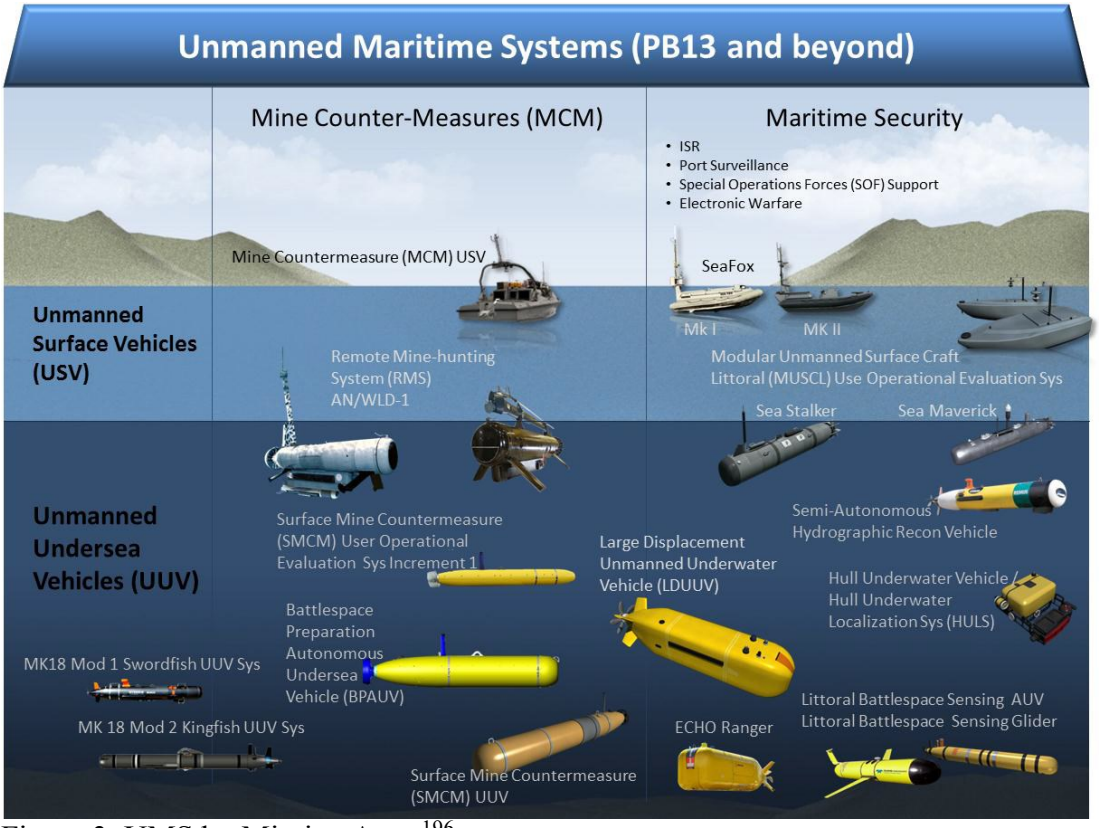

Figure 3. UMS by Mission Area.[196]

Despite the U.S. military having over 10,000 UAS alone and many more unmanned systems spread across the enterprise, only 200-300 are even capable of being

[195] Logan Mock-Bunting, "The Many Challenges of Underwater Communication," *Schmidt Ocean Institute,* April 3, 2016, http://schmidtocean.org/cruise-log-post/the-many-challenges-of-underwater-communication/.
[196] *Ibid,* p. 8.

armed.[197] While there are other unmanned systems being used and developed by other agencies within the U.S government, the amount of readily available information is limited. The Central Intelligence Agency (CIA) is thought to possess a combination of roughly 30 MQ-1 Predator and MQ-9 Reaper UAVs that are operated by the Air Force, though there is no way of verifying this number or how many are armed.[198] The U.S. Air Force also operates the RQ-170 Sentinel for the CIA, which is thought to be a stealthy ISR UAV that was brought down over Iran in December 2011.[199] Additionally, the U.S. Air Force assumed operation of the Boeing X-37 unmanned spacecraft from NASA/DARPA in 2004 and has flown at least four test flights over increasingly longer periods of time.[200] The Department of Homeland Security (DHS) and its Customs and Border Protection agency operate ISR UAVs for domestic law enforcement and have loaned their UAVs to other agencies at least 700 times within the period of 2010-2012.[201] These are but a few examples of the increasing number of unmanned systems in use by the U.S. government today.

International Development and Proliferation

In addition to the U.S. development of unmanned systems, there has been an explosion in development and production internationally of both unarmed and

[197] New America, "World of Drones," *New America*, accessed May 22, 2016, http://securitydata.newamerica.net/world-drones.html.
[198] Greg Miller and Julie Tate, "CIA Shifts Focus to Killing Targets," *Washington Post*, September 1, 2011, https://www.washingtonpost.com/world/national-security/cia-shifts-focus-to-killing-targets/2011/08/30/gIQA7MZGvJ_story.html.
[199] Lateef Mungin, "Iran Claims Released Footage Is from Downed U.S. Drone," *CNN*, February 7, 2013, http://edition.cnn.com/2013/02/07/world/meast/iran-drone-video/.
[200] Phillip Swarts, "X-37B Space Plane Is Shrouded in Mystery," *Air Force Times*, September 26, 2015, http://www.airforcetimes.com/story/military/tech/2015/09/26/x-37b-space-plane-shrouded-mystery/72752826/.
[201] Conor Friedersdorf, "The Rapid Rise of Federal Surveillance Drones over America," *The Atlantic*, March 10, 2016, http://www.theatlantic.com/politics/archive/2016/03/the-rapid-rise-of-federal-surveillance-drones-over-america/473136/.

weaponized systems, following in the wake of the U.S. use of UAVs over the last decade and a half. This growth is largely being driven by a burgeoning UAV market that has reached the converging point between technology and accessibility, as UAVs have become affordable, with off-the-shelf availability, and a low enough barrier to entry technologically, that they are being bought by individuals, industry, and governments alike. This rate of widespread proliferation only really currently applies to UAVs, as the deployment of UGVs, UUVs, and USVs are still fairly limited even within advanced nation-state militaries. While unmanned systems present an attractive and promising future to the benefit of mankind, their rapid and unchecked proliferation may lead to some very undesirable consequences.

The Federal Aviation Administration (FAA) estimates that within a decade the global UAV market will constitute a $90 billion industry.[202] In 2014 the Consumer Electronic Association forecasted domestic private UAV sales to be over $84 million and 250,000 units.[203] By 2015, domestic private UAV sales were $261 million and nearly 1 million units sold.[204] Domestic private sales in 2016 are estimated to grow another 84%, to $481 million and roughly 2.5 million units.[205] By mid-March of 2016, over 408,000 private users had registered their UAVs as part of the FAA's ruling to monitor UAV use,

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[202] Craig Smith, "10 Interesting Drone Statistics," *DMR*, February 6, 2016, http://expandedramblings.com/index.php/drone-statistics/.
[203] Larry Downes, "America Can't Lead the World in Innovation If the FAA Keeps Dragging Its Feet on Drone Rules," *Washington Post*, October 8, 2014, https://www.washingtonpost.com/news/innovations/wp/2014/10/08/america-cant-lead-the-world-in-innovation-if-the-faa-keeps-dragging-its-feet-on-drone-rules/.
[204] Leo Sun, "Drones in 2016: 4 Numbers Everyone Should Know," *The Motley Fool*, February 29, 2016, http://www.fool.com/investing/general/2016/02/29/drones-in-2016-4-numbers-everyone-should-know.aspx.
[205] Greg Sandoval, "Sales of Commercial Drones Will Soar 84% in 2016 — Despite Safety Concerns," *Geek Wire*, January 18, 2016, http://www.geekwire.com/2016/sales-of-commercially-used-drones-will-soar-84-in-2016-despite-safety-concerns/.

which leaves hundreds of thousands of UAVs in the U.S. still unregistered.[206]

Not to be outdone by private buyers, the FAA estimates that in 2017 nearly 2.5 million UAVs will be sold for commercial use alone, as Congress and FAA regulations open up to allow more commercial drone operator licenses.[207] The global commercial UAV market will grow by a compound annual growth rate of 19% over the next five years, driven largely by a handful of industries such as agriculture, photography, and utilities.[208] But the U.S. is lagging behind other countries and regions in the commercial and industrial application of UAVs, due to the slow adaptability of domestic regulations. Countries like China, Israel, Japan, Brazil, and the EU are all pushing for the rapid inclusion of UAVs into their national airspaces for commercial and industrial use.[209] DJI, one of the world's largest UAV manufacturers based in China, was valued at $10 billion in 2015 and was expected to generate nearly $1 billion in sales alone in 2015.[210] China UAV exports in 2015 were valued at over $413 million and the country claims over 400 different drone manufacturers.[211] While there is comparatively little detailed data on the state of the international market, the size and growth of the U.S. domestic market should be an indicator of the trend of global UAV markets.

At the same time, the global proliferation of UAVs, both unarmed and armed, for

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[206] Federal Aviation Administration, "FAA Aerospace Forecasts FY 2016-2036: Unmanned Aircraft Systems," *Federal Aviation Administration,* accessed May 22, 2016, https://www.faa.gov/data_research/aviation/aerospace_forecasts/media/Unmanned_Aircraft_Systems.pdf, p. 31.
[207] *Ibid.*
[208] "THE DRONES REPORT: Market Forecasts, Regulatory Barriers, Top Vendors, and Leading Commercial Applications," *Business Insider*, May 10, 2016, http://www.businessinsider.com/uav-or-commercial-drone-market-forecast-2015-2.
[209] Miriam McNabb, "Regulations Matter: 3 Regions Crushing the U.S. In Drone Industry," *DroneLife*, January 8, 2016, http://dronelife.com/2016/01/08/regulations-matter-3-regions-crushing-the-u-s-in-drone-industry/.
[210] "Drones in 2016: 4 Numbers Everyone Should Know."
[211] Miriam McNabb, "Will China Dominate the Drone Market?" *DroneLife*, January 14, 2016, http://dronelife.com/2016/01/14/will-china-dominate-the-drone-market/.

military use has also risen, although not as dramatically as the private market. In 2005 there were 41 states with complete UAS, which grew to 76 in 2012; in the same time frame, the total number of UAV programs worldwide grew from 195 to over 900.[212] Today there are 86 nation-states with UAV programs, of which only seven have used armed drones in combat, but four other states have demonstrated an armed capability and an additional ten are developing or purchasing armed drones.[213] Between 2010 and 2014 there were 439 UAVs sold to 35 nation-states, of which only 11 UAVs (2.5% of the total) were armed.[214] Israel led exports of UAVs during the 2010-2014 time frame at 165, with the U.S. in second at 132, followed distantly by Italy in third at 37.[215]

UAVs also provide violent non-state actors with potential capabilities that could be easily utilized if they had access to UAVs, armed or not. The characteristics that define the popularity of UAVs, small, cheap, and readily available make the variety of possibilities for their use by non-state actors numerous. Suicide attacks, assassinations, dispersal of chemical or biological agents, attacks on airliners, attacks on transportation or power infrastructure, and dispersal of agents over crops, livestock, or water supplies are but a few examples of ways a terrorist could attack a military or civilian target via UAV. Hamas has experimented with UAVs over several years, most recently in the 2014 Israel-Gaza Conflict, with very limited success, but the group claims to have UAVs

[212]Micah Zenko, "Reforming U.S. Drone Strike Policies," *Council on Foreign Relations*, January 2013, http://www.cfr.org/wars-and-warfare/reforming-us-drone-strike-policies/p29736, p. 18.
[213]"World of Drones."
[214] George Arnett, "The Numbers Behind the Worldwide Trade in Drones," *The Guardian*, March 17, 2015, http://www.theguardian.com/news/datablog/2015/mar/16/numbers-behind-worldwide-trade-in-drones-uk-israel.
[215] *Ibid.*

armed with rockets and suicide devices that operate like a missile. [216] In August 2014, ISIL released video footage from a UAV that it was using to monitor military troop movements in Syria and Iraq.[217] Hezbollah used Iranian supplied UAVs armed with 40-50 kg explosive warheads in its 2006 and 2012 wars with Israel, flew a UAV near the Dimona nuclear complex in April 2013, and has flown several UAVs into Israel to probe air defense reaction times. [218] In September 2013 Hezbollah used an armed UAV to attack an al-Nusra Front compound in Syria.[219] Greater use of UAVs by non-state actors may only be restricted by current technical limitations, though certainly not for a lack of imagination in trying to use them.

Another major concern of the global proliferation of UAVs is their intersection with traditional manned systems in national and international airspaces. The FAA recorded 236 incidents, sightings, or close calls between manned aircraft and UAVs in 2014, which jumped to more than 1,200 incidents in 2015.[220] There were 327 'proximity danger' incidents between December 2013 and September 2015, which meant that a UAV came within 500 feet of a manned aircraft.[221] Of those 327 incidents, 51 of them involved a UAV coming within 50 feet or less of a manned aircraft, with 28 incidents forcing the

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[216] Alexander Smith, "Hamas' Drone Program Will Not Worry Israel, Experts Say," *NBC News*, July 15, 2014, http://www.nbcnews.com/storyline/middle-east-unrest/hamas-drone-program-will-not-worry-israel-experts-say-n155341.
[217] David Cardinal, "Drones Provide Terrorists with a DIY Air Force," *ExtremeTech*, August 29, 2014, http://www.extremetech.com/extreme/188941-drones-provide-terrorists-with-a-diy-air-force.
[218] Milton Hoeing, "Hezbollah and the Use of Drones as a Weapon of Terrorism," *Federation of American Scientists*, June 5, 2014, http://fas.org/pir-pubs/hezbollah-use-drones-weapon-terrorism/.
[219] Peter Bergen and Emily Schneider, "Hezbollah Armed Drone? Militants' New Weapon," *CNN*, September 22, 2014, http://www.cnn.com/2014/09/22/opinion/bergen-schneider-armed-drone-hezbollah/.
[220] "Drone Close Calls with Airliners Surged in 2015," *Newsmax*, March 29, 2016, https://www.newsmax.com/Newsfront/drones-airlines-close-calls-FAA/2016/03/29/id/721290/.
[221] Brakkton Booker, "New Drone Study Finds 327 'close encounters' with Manned Aircraft," *NPR*, December 11, 2015, http://www.npr.org/sections/thetwo-way/2015/12/11/459366656/new-drone-study-finds-327-close-encounters-with-manned-aircraft.

piloted aircraft to maneuver to avoid collision with the UAV.[222] In comparison, there is currently no known group monitoring UAV incidents at an international level, though they are likely numerous as well.

While nowhere near as developed as UAVs, there are other unmanned systems being deployed and marketed abroad. The modular Israeli Guardium UGV has been used to guard remote areas of the Sinai, airports, and other high value civilian targets since 2008.[223] Russia has recently developed at least two UGVs, the Taifun-M Armored Reconnaissance Vehicle used for ICBM silo security[224] and the Uran-9 mini-tank which is designed for reconnaissance and fire support to manned systems.[225] In early April 2016 an Israeli Harop loitering munition was used by Azerbaijani forces in the ongoing dispute with Armenia over Nagorno-Karabakh, one of several hundred supposedly sold according to manufacturer IAI.[226] South Korean defense firm DoDaam Systems has built an automated .50 caliber stationary turret, the Super Aegis II, which is deployed along the demilitarized zone with North Korea and at numerous locations in the Middle East.[227] These examples of the international development and deployment of unmanned systems, are likely to play a continuing role in the debate over LAWS.

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[222] *Ibid.*
[223] Andrew Tarantola, "This Unmanned Patroller Guards Israeli Borders for Days on End," *Gizmodo*, September 14, 2012, http://gizmodo.com/5943055/the-g-nius-guardium-guards-golan-like-a-golem.
[224] "Russia Shows Off World-Leading Security Bots for Missile Bases," *Sputnik News*, December 27, 2014, http://sputniknews.com/military/20140422/189307020/Russia-Shows-Off-World-Leading-Security-Bots-for-Missile-Bases.html.
[225] Kyle Mizokami, "The Kremlin's Tiny Drone Tank Bristles with Weapons," *Popular Mechanics*, January 13, 2016, http://www.popularmechanics.com/military/weapons/a18948/russias-new-ground-combat-drone-uran-9/.
[226] Thomas Gibbons-Neff, "Israeli-Made Kamikaze Drone Spotted in Nagorno-Karabakh Conflict," *Washington Post*, April 5, 2016, https://www.washingtonpost.com/news/checkpoint/wp/2016/04/05/israeli-made-kamikaze-drone-spotted-in-nagorno-karabakh-conflict/.
[227] Simon Parkin, "Killer Robots: The Soldiers That Never Sleep," *BBC*, July 16, 2015, http://www.bbc.com/future/story/20150715-killer-robots-the-soldiers-that-never-sleep.

The Efficacy of Drone Warfare

In the aftermath of the horrors unleashed by 19 hijackers armed with simple weapons on 11 September 2001, the U.S. launched headlong into the fray of the War on Terror, a conflict markedly different from any it had previously waged, against an enemy it little understood and was scant prepared for fighting. As months changed into years after the launch of Operation Enduring Freedom-Afghanistan (OEF-A) on October 7, 2001, it became increasingly apparent that the conventional conflict in Afghanistan was reaching the limits of its effectiveness. The terrorists that the U.S. was engaged with moved across international borders, lived within remote and inhospitable areas, and hid among civilian populations for long periods of time, not interested in staying boxed within or adhering to a traditional neat little conflict zone. The U.S. quickly needed a new set of tactics for dealing with the unique parameters of the conflict and turned to recent developments in weaponizing UAVs to meet the challenge. In the years since the first credited ‘kill' by an American UAV in October of 2001, there has been an enduring debate on a multitude of aspects of the popularly termed “drone warfare.” Although it has long been the U.S. government's stance to generally deny the specifics of a policy of “targeted killing” by “drone strike,” it is perhaps one of the worst kept secrets of the War on Terror and has been a hotly contested issue for more than a decade.

The issue of drone warfare has repeatedly raised the question of its efficacy to meet desired U.S. goals in both the short and long term, which can be further echoed in the debate over LAWS. As the perceived precursor to LAWS, how weaponized UAVs have been and are being used has had a direct impact in the discourse of the UN CCW Meeting of Experts on LAWS. With various facts and opinions on weaponized UAVs and

drone warfare being utilized as the basis to debate a prohibition on LAWS, it is imperative that the efficacy of the program also be considered in the discussion. In asking the question of efficacy however, it is important to define what the desired result is. The program of targeted killings, mostly by armed UAVs, has been used by both the Bush and Obama administrations as a key tool of U.S. counterterrorism policy in the War on Terror, which suggests that the efficacy of drone warfare should be whether or not it meets the goals of U.S. counterterrorism policy.[228]

So what then are the goals of U.S. counterterrorism policy? According to the Obama administration's 2011 National Strategy for Counterterrorism, the overarching goals of U.S. counterterrorism policy are:[229]

- Protecting our homeland by constantly reducing our vulnerabilities and adapting and updating our defenses.
- Disrupting, degrading, dismantling and defeating al-Qa'ida wherever it takes root.
- Preventing terrorists from acquiring or developing weapons of mass destruction.
- Eliminating the safehavens al-Qa'ida needs to train, plot and launch attacks against us.
- Degrading links between al-Qa'ida, its affiliates and adherents.
- Countering al-Qa'ida ideology and its attempts to justify violence.
- Depriving al-Qa'ida and its affiliates of their enabling means, including illicit financing, logistical support, and online communications.

The goals outlined by the Obama administration are similar, but somewhat different from the Bush administration's goals in the 2003 National Strategy for Combating Terrorism:

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[228] Jonathan Masters, "Targeted Killings," *Council on Foreign Relations*, May 23, 2013, http://www.cfr.org/counterterrorism/targeted-killings/p9627.

[229] The White House Office of the Press Secretary, "Fact Sheet: National Strategy for Counterterrorism," *The White House*, June 29, 2011, https://www.whitehouse.gov/the-press-office/2011/06/29/fact-sheet-national-strategy-counterterrorism.

"defeat terrorists and their organizations; deny sponsorship, support, and sanctuary to terrorists; diminish the underlying conditions that terrorists seek to exploit; defend U.S. citizens and interests at home and abroad." [230]

In-order to determine the efficacy of U.S. drone policy, we must at a minimum consider the goals and objectives of U.S. counterterrorism policy, of which drone strikes are one select tool from the toolbox. But can or should the efficacy of drone warfare be based solely on its capability to meet the goals of U.S. counterterrorism policy? Perhaps in a truly isolated sociopolitical vacuum this would be the case, but international affairs, particularly in the Bush administration termed "Greater Middle East" where drone strikes are being utilized, are anything but. Maybe the efficacy of drone warfare should be extended to include U.S. foreign policy goals or possibly U.S. national security goals? Perhaps we should include considerations of the alternatives to reach the same objectives, such as the potential risk to our own forces, economic value, and the total impact on civilians and civilian property? Indeed, the debate over efficacy could be expanded to include as many other goals, objectives, and considerations as one sees fit, enabling a never ending argument over the efficacy of drone warfare. That debate is worthy of an entire paper all itself, but for the purpose of this paper we will generally gauge the efficacy of drone warfare based on knowable statistics and U.S. counterterrorism goals and objectives, while also noting general concerns about U.S. policy goals at large. In doing so, the paper will examine the efficacy on both a country-by-country basis and for the greater whole.

The current U.S. drone warfare program can be split into one program managed

[230]The White House, "National Strategy for Combating Terrorism," *The White House*, February 2003, https://www.cia.gov/news-information/cia-the-war-on-terrorism/Counter_Terrorism_Strategy.pdf, p. iii.

by the U.S. military, which has jurisdiction for battlefield UAV use, and another by the Central Intelligence Agency (CIA), which manages covert drone operations in non-declared battlefield spaces. As the use and reliance upon UAVs, particularly weaponized ones, expanded during the 2000s and into this decade, so too did the number of UAVs in the U.S. arsenal. When the War on Terror began in 2001, the U.S. only had some 50 UAVs, but today the U.S. fleet contains over 10,000.[231] In 2005 UAVs only accounted for 5% of U.S. military aircraft, but by 2012 UAVs accounted for over 31% and the number has only continued to grow.[232] As the number of UAVs increased, so too did their usage, from 10,000 flight hours in 2005, to 550,000 flight hours in 2010.[233] The budget for procurement and development of UAVs has also increased dramatically, while the military investment in FY2001 was around $667 million, it ballooned to $3.9 billion in FY2012.[234] U.S. UAV fleet growth is also the law; in 2000 the U.S. Congress mandated the goal of making UAVs account for a third of the U.S. Air Force's (USAF) deep strike force operations aircraft.[235]

As a battlefield tactic, drone strikes are not altogether different from an airstrike from a traditional aircraft, but there are a few differences that, along with the way the tactic is being used in non-declared battlefields, is cause for vilification by opponents. By design, UAVs allow a platform to remain on target anywhere from 15-25 hours, compared with 4-6 hours for an F-16 fighter jet, all the while not placing pilots or ground

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[231]Peter Bergen and Jennifer Rowland, "A Dangerous New World of Drones," *CNN*, October 8, 2012, http://www.cnn.com/2012/10/01/opinion/bergen-world-of-drones/.
[232]Spencer Ackerman and Noah Shachtman, "Almost 1 in 3 U.S. Warplanes Is a Robot," *Wired*, January 9, 2012, https://www.wired.com/2012/01/drone-report/.
[233]U.S. Government Accountability Office, "Nonproliferation: Agencies Could Improve Information Sharing and End-Use Monitoring on Unmanned Aerial Vehicle Exports," *U.S. Government Accountability Office* (GAO-12-536), July 30, 2012, http://www.gao.gov/assets/600/593131.pdf, p. 14.
[234]Jeremiah Gertler, "U.S. Unmanned Aerial Systems," *Congressional Research Service* (R42136), January 3, 2012, https://www.fas.org/sgp/crs/natsec/R42136.pdf, p. 2.
[235]*Ibid.*

forces in harm's way over hostile territory.[236] Additionally, armed UAVs can provide a near-instantaneous response to a targeting opportunity, compared with the time required to bring assets to bear against a target from either support aircraft or cruise missile launches from ships and submarines. The AGM-114 Hellfire missile, the weapon found in most armed UAV payloads, has a limited collateral damage spread, as it is an anti-tank missile, which is designed for penetration power instead of large explosions and shrapnel. The Hellfire missile moves faster than the speed of sound, which from 30,000 feet can impact a target within seconds, often before it is heard on the ground or before target environment conditions change.[237]

Yet for all the pros supporting the use of UAVs compared with other strike capabilities, it is the way drone strikes are being used that draws the most ire. UAVs are like any other strike platform, in that they rely upon intelligence sources for target acquisition, but the operating environment of most UAV targets are not conductive for thorough target screening. This has led to a tactic known as "signature strikes," which selects targets based upon a behavior pattern matrix of actions, location, and timing to determine if a target is valid, without the use of corroborative intelligence.[238] Another employed tactic, has been the use of "double-tap strikes," which targets those who enter the target area after an initial strike, on the assumption that any would be rescuers are fellow terrorists.[239] Additional targets have also been selected based around attendance to

[236]"Reforming U.S. Drone Strike Policies," p. 6.
[237]*Ibid.*
[238] Cora Currier, "Everything We Know So Far about Drone Strikes," *ProPublica*, February 5, 2013, https://www.propublica.org/article/everything-we-know-so-far-about-drone-strikes.
[239] Tara McKelvey, "Drones Kill Rescuers in 'double tap', Say Activists," *BBC*, October 22, 2013, http://www.bbc.com/news/world-us-canada-24557333.

mosques, funerals, or community gatherings with known targets.[240] While drone strikes were originally credited as being an effective tactic against High Value Targets (HVTs), they are increasingly being used against targets with low or questionable value, often with no known terrorist connection.[241]

In discussing the issue of drone strikes, it is important to caveat much of the data surrounding the discussion. The Obama administration only recently published a short three-page report on 1 July 2016 that briefly summarizes "U.S. Counterterrorism Strikes Outside Areas of Active Hostilities;" one of the few official disclosures of relevant data.[242] According to the report, between 20 January 2009 and 31 December 2015 the U.S. carried out 473 strikes, which killed 2,372-2,581 combatants and 64-116 non-combatants.[243] The report offers few distinctions, as it does not define which organizations of the "U.S. government" carried out the strikes, whether the "strikes" included only drone strikes or both drone strikes and more conventional strikes, whom or what encompasses the broadly defined "terrorist targets," and only notes the "areas of active hostilities," Afghanistan, Iraq, and Syria, but not where the "strikes outside areas of active hostilities" took place.[244]

Because so little official data exists on drone strikes, a number of nongovernmental organizations, journalists, news agencies, and other secondary sources

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[240] Chris Woods and Mushtaq Yusufzai, "Get the Data: The Return of Double-Tap Drone Strikes," The Bureau of Investigative Journalism, August 1, 2013, https://www.thebureauinvestigates.com/2013/08/01/get-the-data-the-return-of-double-tap-drone-strikes/.
[241] Greg Miller, "Increased U.S. Drone Strikes in Pakistan Killing Few High-Value Militants," *Washington Post*, February 21, 2011, http://www.washingtonpost.com/wp-dyn/content/article/2011/02/20/AR2011022002975.html.
[242] Office of the Director of National Intelligence, "Summary of Information Regarding U.S. Counterterrorism Strikes Outside Areas of Active Hostilities," *Office of the Director of National Intelligence,* July 1, 2016, https://www.dni.gov/files/documents/Newsroom/Press%20Releases/DNI+Release+on+CT+Strikes+Outside+Areas+of+Active+Hostilities.PDF.
[243] *Ibid.*
[244] *Ibid.*

have filled the vacuum with data sets that have been acquired from a wide range of sources. These secondary sources include the Bureau of Investigative Journalism, New America, and the Foundation for Defense of Democracies, among other groups and organizations. Because of the nature of the drone strike program, the reporting area, the individuals and groups targeted, differences in definitions, and the range of sources of data, it is extremely difficult for groups to determine accurate counts of drone strikes and casualties.[245] As such, there exists discrepancies between reporting groups and the U.S. government and between the reporting groups themselves, and while the paper attempts to examine multiple data sources and data ranges in the following discussion, it is salient to remember the limitations that such data affords in lieu of official data.

While the use of drone strikes in the War on Terror began under President George W. Bush, they are considered a signature hallmark of President Barack Obama's administration. Under President Bush, the CIA or U.S. military reportedly carried out 51 strikes in Pakistan that killed 377-558 people, [246] one strike in Yemen that killed six,[247] and an unknown number in Afghanistan and Iraq. Under President Obama, the CIA or U.S. military have reportedly carried out at least 370 strikes in Pakistan that have killed 1905-3063 people, [248] 106 strikes in Yemen that have killed 492-725,[249] 17 strikes in

[245] Ritka Singh, "Drone Strikes Kill Innocent People. Why Is It So Hard to Know How Many," *New Republic,* October 25, 2013, https://newrepublic.com/article/115353/civilian-casualties-drone-strikes-why-we-know-so-little.
[246]Bureau of Investigative Journalism, "CIA drone strikes in Pakistan, 2004 to present," *Bureau of Investigative Journalism,* accessed May 22, 2016, https://docs.google.com/spreadsheets/d/1NAfjFonM-Tn7fziqiv33HlGt09wgLZDSCP-BQaux51w/edit?pref=2&pli=1#gid=1000652376.
[247] Bureau of Investigative Journalism, "US strikes in Yemen, 2002 to present," *Bureau of Investigative Journalism,* accessed May 22, 2016, https://docs.google.com/spreadsheets/d/1lb1hEYJ_omI8lSe33izwS2a2lbiygs0hTp2Al_Kz5KQ/edit?pref=2&pli=1#gid=977256262.
[248] "CIA drone strikes in Pakistan, 2004 to present."
[249] "US strikes in Yemen, 2002 to present."

Somalia that have killed 33-121 people,[250] 105 strikes in Libya,[251] 1,015 strikes in Afghanistan,[252] and 48 in Iraq.[253] Drone strikes by UAVs have enjoyed a bipartisan popularity in both U.S. public opinion polls and in the U.S. Congress, with 58% of Americans approving of their use and a majority approval among both political parties.[254] Yet that same approval is not shared in much of the rest of the world and in particular in the Greater Middle East, which has an overwhelmingly negative view on the issue of drone strikes.[255]

U.S. drone policy in Pakistan is perhaps the most well documented of all countries in which the U.S. has reportedly employed drone strikes, with drone strikes beginning in June 2004 and continuing through the present. There have been more strikes in Pakistan than in any other non-declared battlefield country and the missions are reportedly under the command of the CIA, which originally launched missions from airbases within Pakistan, but now launches them from Afghanistan, after a rift in U.S.-Pakistani relations in 2011.[256] Under the Bush administration the CIA reportedly carried out an estimated 48 strikes in Pakistan that killed 377-558 people, of which 205-348 were

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[250] Bureau of Investigative Journalism, "US strikes in Somalia, 2007 to present," *Bureau of Investigative Journalism,* accessed May 22, 2016, https://docs.google.com/spreadsheets/d/1-LT5TVBMy1Rj2WH30xQG9nqr8-RXFVvzJE_47NlpeSY/edit?pref=2&pli=1#gid=1110953463.
[251] Chris Woods and Alice Ross, "Revealed: US and Britain Launched 1, 200 Drone Strikes in Recent Wars," *Bureau of Investigative Journalism*, December 4, 2012, https://www.thebureauinvestigates.com/2012/12/04/revealed-us-and-britain-launched-1200-drone-strikes-in-recent-wars/.
[252] *Ibid.*
[253] *Ibid.*
[254] Pew Research Center, "Public Continues to Back U.S. Drone Attacks," *Pew Research Center*, May 28, 2015, http://www.people-press.org/2015/05/28/public-continues-to-back-u-s-drone-attacks/.
[255] Pew Research Center, "Global Opposition to U.S. Surveillance and Drones, but Limited Harm to America's Image," *Pew Research Center,* July 14, 2014, http://www.pewglobal.org/2014/07/14/global-opposition-to-u-s-surveillance-and-drones-but-limited-harm-to-americas-image/.
[256] "U.S. Forces Begin Leaving Pakistan Drone Base," *Reuters*, December 5, 2011, http://www.reuters.com/article/usa-pakistan-drones-idUSN1E7B40U220111205.

militants, 126-154 were civilians, and 46-56 were indeterminate in combatant stance.[257] Of those reported strikes, 18 were against al-Qaeda, 16 were against targets whose affiliation was unclear, 10 against the Taliban, two against the Haqqani, and two against BM.[258] Under the Obama administration the CIA has reportedly carried out an estimated 353 strikes in Pakistan that have killed 1905-3063 people, of which 1646-2680 were militants, 129-161 were civilians, and 130-222 were indeterminate in combatant stance.[259] Of those reported strikes, 158 were against targets whose affiliation was unclear, 110 were Taliban, 34 were Haqqani, 32 were al-Qaeda, 13 were BM, three were IMU, and two were Maulvi Nazir.[260]

While the frequency and tempo of drone strikes have reportedly rapidly accelerated under the Obama administration, other relevant numbers appear to have decreased. Under the reported Bush administration strike numbers, the civilian casualty rate per strike was 3.3, the percent of unknown casualties was 40%, and the total casualty rate per strike was 8.0.[261] Under the Obama administration the reported civilian casualty rate per strike is 0.7, the percent of unknown casualties is just under 7%, and the total casualty rate per strike is 5.6.[262] Yet over the course of the reported 401 drone strikes only 58 known militant leaders have been killed, representing only 2% of all deaths.[263]

Reported drone strikes in Pakistan are primarily limited to the Federally Administered Tribal Areas and the Northwest Frontier province, areas where Pakistan has

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[257] New America, "Drone Wars Pakistan: Analysis," *New America*, accessed May 22, 2016, http://securitydata.newamerica.net/drones/pakistan-analysis.html.
[258] *Ibid.*
[259] *Ibid.*
[260] *Ibid.*
[261] "CIA drone strikes in Pakistan, 2004 to present."
[262] *Ibid.*
[263] New America, "Key Findings: Drone Wars Pakistan," *New America*, accessed May 22, 2016, http://securitydata.newamerica.net/drones/key-findings.html?country=Pakistan.

limited control of the territory and people living there. The Pakistani government has tended to be ambivalent in its opinion of U.S. drone strikes, at times publicly condemning U.S. violation of Pakistani sovereignty, while quietly feeding the CIA new target lists and encouraging the use of even more drone strikes.[264] Yet Pakistani public opinion of the U.S. and drone strikes has plummeted over the years, especially worrisome for a supposed U.S. ally in the region. In Pakistan, 72% view America unfavorably, President Obama receives only a 10% approval rating, only 13% think U.S.-Pakistani relations have improved, and 68% of Pakistanis oppose U.S. drone strikes.[265] Public perception of the powerlessness (or tacit consent) of the Pakistani government to end U.S. drone strikes in Pakistan, has only served to further agitate public disapproval of the central government and fueled questions of its legitimacy.[266]

It is difficult to determine the effect that drone strikes have had on Pakistan as a whole, but by many standards it would not appear at first blush to be a net positive. The Pakistani government is under increasingly intense pressure from public opinion and domestic opposition to put an end to U.S. drone strikes, which when coupled with anti-American sentiments over other issues, has only served to drive a wedge between the political establishment, the military, and the people.[267] Additionally, despite the Pakistani government's appreciation of drone strike targets, U.S. drone strikes have also multiplied the number of enemies that the government must deal with. Islamic militant networks

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[264] "Secret Memos 'Show Pakistan Endorsed US Drone Strikes'," *BBC*, October 24, 2013, http://www.bbc.com/news/world-asia-24649840.
[265] Pew Research Center, "On Eve of Elections, a Dismal Public Mood in Pakistan," *Pew Research Center*, May 7, 2013, http://www.pewglobal.org/2013/05/07/on-eve-of-elections-a-dismal-public-mood-in-pakistan/.
[266] Lisa Schirch, "9 Costs of Drone Strikes," *Huffington Post*, June 28, 2012, http://www.huffingtonpost.com/lisa-schirch/drones_b_1630592.html.
[267]Michael Boyle, "The Costs and Consequences of Drone Warfare," International Affairs 89: 1 (2013), http://5ton.pl/wp-content/uploads/2015/02/drone-warfare_costs-consequences_chatham_Boyle_2013.pdf, p. 14-19.

with little capability to threaten the U.S., but with an increasingly larger chip against the Pakistani central government, have seen ranks swell with fresh recruits angry over U.S. drone strikes and willing to fight against the seemingly complicit central government.[268] While U.S. drone strikes in Pakistan have definitely served to thin the ranks and decimate the capability of al-Qaeda Central, our measure of efficacy must take note of the destabilizing factor that drone strikes may have on potential U.S. long-term objectives in Pakistan.

U.S. drone policy in Yemen has more recently captured international attention with the outbreak of the Yemeni Civil War in February 2015, but like in Pakistan, U.S. drone strikes have been well documented for years. The first drone strike was in March 2002 followed by a gap of nine years until drone strikes resumed in May 2011.[269] Unlike with Pakistan, both the CIA and the Joint Special Operations Command (JSOC) reportedly run drone strikes in Yemen from basing in Djibouti and Saudi Arabia, which have been more willing partners in executing the missions.[270] Also unlike Pakistan, the U.S. has used conventional aircraft strikes, cruise missile strikes, and special operations raids in Yemen, usually at the behest of the Yemenis government.[271] Under the Bush administration only one drone strike was launched on March 11, 2002, against a known al-Qaeda leader, which killed six militants and no civilians.[272] Under the Obama

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[268] *Ibid.*
[269] New America, "Drone Wars Yemen: Analysis," *New America,* accessed May 22, 2016, http://securitydata.newamerica.net/drones/yemen-analysis.html.
[270] Craig Whitlock, "Remote U.S. Base at Core of Secret Operations," *Washington Post*, October 25, 2012, https://www.washingtonpost.com/world/national-security/remote-us-base-at-core-of-secret-operations/2012/10/25/a26a9392-197a-11e2-bd10-5ff056538b7c_story.html.
[271] Scott Shane, "Yemen's Leader, President Hadi, Praises U.S. Drone Strikes," *New York Times*, August 25, 2014, http://www.nytimes.com/2012/09/29/world/middleeast/yemens-leader-president-hadi-praises-us-drone-strikes.html?_r=0.
[272] David Johnston and David E. Sanger, "Yemen Killing Based on Rules Set out by Bush," *New York Times*, November 6, 2002, http://www.nytimes.com/2002/11/06/international/middleeast/06YEME.html.

administration it is reportedly estimated that 122 strikes have been initiated in Yemen that have killed 897-1155 people, of which 780-1013 were militants, 87-93 were civilians, and 30-49 were against targets whose affiliation was unclear.[273] There is an additional 80-96 reported airstrikes that might be attributable either to Yemenis aircraft or to U.S. drones, that have killed 334-486 people, of which 308-425 were militants and 26-61 were civilians.[274] All of the reported strikes undertaken by both the Bush and Obama administrations have been against al-Qaeda, rebranded first as Ansar al Sharia and then later as al-Qaeda in the Arabian Peninsula (AQAP).[275]

With only one drone strike under the Bush administration compared with the 122 reported strikes under the Obama administration, it would be unfair to compare the statistical effectiveness of their drone strike policies. Reported civilian and unknown affiliation casualty rates over the course of the Obama administration have averaged between 14-15%, notably higher than in Pakistan, but have been steadily on the decline.[276] Whereas reported drone strikes lessened in frequency in Pakistan after 2011, they began to spike in Yemen during 2012 alongside the Yemeni government air campaign against AQAP and over the course of 122 reported drone strikes at least 35 known AQAP militant leaders have been killed.[277]

Much like with Pakistan, drone strikes in Yemen have been fairly well documented, but are also a subject of some debate among monitoring non-governmental organizations, particularly on the validity of the other potential U.S. drone strikes. Drone

[273] "Drone Wars Yemen: Analysis."
[274] "US strikes in Yemen, 2002 to present."
[275] "Drone Wars Yemen: Analysis."
[276] New America, "Key Findings: Drone Wars Yemen," *New America*, accessed May 22, 2016, http://securitydata.newamerica.net/drones/key-findings.html?country=Yemen.
[277] *Ibid.*

strikes in Yemen have been scattered across the country, but are most frequent in the north and central of the country where AQAP is well entrenched and the Yemeni government has even less control than it normally does. The Yemeni government has been more welcoming of U.S. drone strikes against AQAP and has supplied the U.S. with intelligence for target acquisition, which has placed it at odds with its restive population, particularly in the north.[278] While there is little to go by in the way of public opinion data in Yemen, one poll conducted in 2007 found that 73.5% of Yemenis believed American involvement in the Middle East was justification for attacks on Americans, a shocking statistic well before the glut of drone strikes under the Obama administration.[279]

With the collapse of Yemen into a civil war in February 2015, it has become increasingly difficult for U.S. drones to operate in Yemen, but that has not slowed the drone strike tempo.[280] The difficulty in determining the effect of drone strikes in Yemen is the sheer number of problems facing the country, of which U.S. drone strikes are but one contentious issue and likely not the biggest one to most people.[281] Much like in Pakistan, U.S. drone strikes could be seen to have weakened the legitimacy of the Yemeni government to handle its numerous problems, which has been exploited by AQAP to justify their campaign against the Sunni central government.[282] Additionally, many Yemenis believe U.S. drones to be the source of all airstrikes in Yemen, whether the U.S. is involved or not, which has fueled an already agitated civilian population to forgo trust

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[278] Mohammed Ghobari, "Yemen Asks U.S. For Drones to Fight Al Qaeda," *Reuters*, August 22, 2013, http://www.reuters.com/article/us-yemen-usa-drones-idUSBRE97L0PZ20130822.
[279]Jillian Schwedler, "Is the U.S. Drone Program in Yemen Working?" *Brookings Institute*, September 28, 2015, http://www.brookings.edu/blogs/markaz/posts/2015/09/29-us-drone-program-yemen.
[280] "US strikes in Yemen, 2002 to present."
[281] Mark Reynolds, "Chafee Says Drone Strikes Drive the Unrest in Yemen," *Politifact Rhode Island*, July 28, 2015, http://www.politifact.com/rhode-island/statements/2015/jul/26/lincoln-chafee/chafee-says-drone-strikes-drive-unrest-yemen/.
[282] "Is the U.S. drone program in Yemen working."

in the central government and instead increasingly ally themselves with Islamic militant groups.[283] AQAP has seen its ranks swell in recent years and the Islamic State has also managed to secure a foothold in Yemen.[284] While the efficacy of U.S. drone policy in Yemen is unlikely the cause of Yemen's descent into chaos, we must note the role that drone strikes might play in undermining U.S. long-term objectives in Yemen.[285]

U.S. drone policy in Somalia and Libya has been documented to a much lesser extent than in Pakistan and Yemen, with fewer total strikes and less clarity in reporting. U.S. drone strikes in Somalia have reportedly been undertaken by JSOC and possibly the CIA, from various bases in and around the Horn of Africa, all of which have occurred under the Obama administration.[286] Like Yemen, the U.S. has also utilized conventional aircraft strikes, cruise missile strikes, naval bombardment, and special operations in Somalia in addition to drone strikes. Under the Obama administration it is reported that 17-21 drone strikes were carried out in Somalia that have killed 33-121 people, of which 33-114 were militants and 0-7 were civilians, with all drone strikes against al-Shabaab or its affiliates, reaching their highest frequency in 2015.[287]

The USAF under the Obama administration carried out 105 drone strikes in Libya that killed an unknown number of people, with no way to breakdown the number of enemy combatants or civilians killed by U.S. drone strikes.[288] U.S. drone strikes in Libya were flown in support of Operation Unified Protector during the multi-state coalition

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[283] "The Costs and Consequences of Drone Warfare," p. 19-20.
[284] Shuaib Almosawa, Kareem Fahim, and Eric Schmitt, "Islamic State Gains Strength in Yemen, Challenging Al Qaeda," *New York Times*, December 15, 2015, http://www.nytimes.com/2015/12/15/world/middleeast/islamic-state-gains-strength-in-yemen-rivaling-al-qaeda.html?_r=0.
[285] "Is the U.S. drone program in Yemen working."
[286] "Remote U.S. Base at Core of Secret Operations."
[287] "US strikes in Somalia 2007 to present."
[288] "Revealed: US and Britain launched 1,200 drone strikes in recent wars."

military intervention in Libya from 19 March to 31 October 2011 and were flown by the USAF and NATO partners, but there have also potentially been additional drone strikes undertaken after 2011 by the Obama administration.[289] Drone strikes in Libya accounted for only a handful of the total number of conventional strikes launched from a variety of other platforms in the duration of the conflict and an even smaller number potentially in post-intervention Libya.[290] While drone strikes in Libya were originally isolated to a limited seven-month time frame in 2011, the Obama administration has undertaken at least one drone strike since the end of the coalition intervention. The recent killing of a top Islamic State leader in Libya on November 14, 2015, likely marks a shift in how the Obama administration intends to deal with Islamic militants in North Africa.[291]

U.S. drone strikes in Somalia and Libya have been lightly documented, with little debate over the numbers because so few non-governmental organizations are actively monitoring the drone programs in those countries. Reported drone strikes in Somalia and Libya have been dispersed throughout those countries; in Somalia the porous nature of the country allows al-Shabaab to move freely throughout the south of the country and in Libya the need to target the forces of then Libyan strongman Muammar Gaddafi wherever they were encountered. The Somali government has been a willing partner to U.S. drone strikes within the country in support of its operations to defeat al-Shabaab and solidify government control of the exceptionally fragile country.[292] The lack of any single central government in Libya has allowed the U.S. the capability to strike the fledgling

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[289] *Ibid.*
[290] *Ibid.*
[291]Gordon Lubold, "U.S. Strikes a Top Islamic State Operative in Libya," *Wall Street Journal*, November 15, 2015, http://www.wsj.com/articles/u-s-strikes-a-top-islamic-state-operative-in-libya-1447533324.
[292] W J Hennigan and David S Cloud, "U.S. Airstrikes in Somalia Signal a More Direct Role Against Shabab," *Los Angeles Times,* July 23, 2015, http://www.latimes.com/world/la-fg-us-airstrikes-somalia-20150723-story.html.

Islamic State in Libya and will likely be the case for some time to come. Neither Somalia nor Libya have the capability to gauge public opinion on domestic matters, let alone opinion of U.S. drone policy in their respective countries, though one could imagine that it might be viewed unfavorably.

It is easier to determine the effect that U.S. drone strikes have had on Somalia and Libya, thus far, than on Pakistan or Yemen. In Somalia, the previous lack of any stable form of government or even something recognizing a cohesive state, has been replaced with a fragile, but increasingly capable government and military. The breakup of the Islamic Courts Union in 2006, the solidification of control of Mogadishu in 2011, and ongoing Somali military operations have devastated al-Shabaab numerically and territorially, though they are still a sizable force.[293] In Libya, U.S. drone strikes as part of the larger air campaign by the coalition, were able to rapidly route the Libyan forces loyal to Gaddafi, but it is difficult to separate the effect that the drone strikes in particular had, as opposed to the effect of the larger air campaign as a whole. However, the complete collapse of the Libyan state as a direct result of the capitulation of Gaddafi, has led many to deem the coalition intervention a failure, which has fostered a growing number of increasingly hostile Islamic militant factions, to include a branch of the Islamic State.[294]

U.S. drone policy in Afghanistan and Iraq has been documented in a rather piecemeal fashion over the years, since the beginning of the U.S. led invasions on October 7, 2001, and March 20, 2003, respectively. Both Afghanistan and Iraq were declared battlefields until December 2014 and December 2011, respectively, which would

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[293] Katherine Zimmerman, "Al Shabaab in Decline?" *AEI*, May 8, 2012, http://www.criticalthreats.org/somalia/zimmerman-al-shabaab-in-decline-may-8-2012.
[294] Alan Kuperman, "Obama's Libya Debacle," *Foreign Affairs,* March/April 2015, https://www.foreignaffairs.com/articles/libya/obamas-libya-debacle.

have placed drone strikes under the command of the U.S. military. Post declared battlefield combat has seen the U.S. military act in a counterterrorism role in both Afghanistan and Iraq, while the CIA has likely had some role to play in support to the military. An unknown number of drone strikes were launched by the U.S. military under the Bush administration during the duration of its conduct of the Afghan and Iraq Wars, whose effect would likely be indistinguishable from the plethora of conventional airstrikes launched and ground forces committed during the same time frame. Unlike the Bush administration, the Obama administration released monthly and yearly conventional aircraft and drone strike numbers in both Afghanistan and Iraq until 2013, when the U.S. military abruptly ended the disclosures.[295]

During the reported years that Afghanistan and Iraq were declared battlefields, the U.S. military under the Obama administration launched 1,015 drone strikes in Afghanistan and 48 drone strikes in Iraq, that killed an unknown number of people.[296] Despite the end of U.S. combat operations in Afghanistan and a renewed focus on the counterterrorism mission in the country, the tempo of U.S. drone strikes appears to be similar to previously reported years. Under the Obama administration in 2015 it is estimated that the USAF has reportedly carried out 175 strikes in Afghanistan that killed 749-1,131 people, of which 705-1,028 were militants and 44-103 were civilians.[297] It is currently unknown how many drone strikes have been launched by the U.S. military in Iraq since June 2014 in support of the U.S. led coalition to defeat the Islamic State, but

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[295] "U.S. Air Force Stops Reporting Data on Afghan Drone Strikes," *Reuters*, March 10, 2013, http://www.reuters.com/article/us-usa-afghanistan-drones-idUSBRE92903520130310.
[296] "Revealed: US and Britain launched 1,200 drone strikes in recent wars."
[297] Jack Serie and Payenda Sargand, "Get the Data: A List of US Air and Drone Strikes, Afghanistan 2015," *Bureau of Investigative Journalism*, February 12, 2015, https://www.thebureauinvestigates.com/2015/02/12/us-drone-war-afghanistan-list-american-air-strikes-2015/#AFG109.

there have been a few documented cases.[298]

Reporting on U.S. drone strikes in Afghanistan and Iraq has been incredibly sparse, only recently having been picked up by the Bureau of Investigative Journalism, likely because of their nature as previously declared battlefields. The Afghani government, like the Pakistani government, has tended to be very ambivalent in its opinion of U.S. drone strikes; at times it has been outright hostile in publicly condemning the U.S., while other times it is seen as silently endorsing U.S. drone strikes.[299] The Iraqi government has been a more willing partner to U.S. drone strikes against the Islamic State, largely due to a continued lack of capability to contain its spread.[300]

While it is difficult to determine exactly what effect U.S. drone strikes have had on Afghanistan and Iraq, opponents to the use of drone strikes have used the current state of affairs in the respective countries as a measurement to suggest their efficacy is very bad. Over 14 years after the invasion of Afghanistan by the U.S. led coalition, the war in Afghanistan has no end in sight; while al-Qaeda Central has been devastated from a prolonged campaign of U.S. drone strikes, the Taliban and its affiliates are still capable of holding territory in a substantial portion of the country.[301] Iraq has broken further apart in the years since the U.S. withdrawal from the country, delving quickly into sectarian violence between Shias and Sunnis and the proxies of other regional powers. The

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[298] Greg Botelho and Barbara Starr, "U.S. 'Reasonably certain' Drone Strike Killed ISIS Mouthpiece 'Jihadi john,'" *CNN*, November 14, 2015, http://www.cnn.com/2015/11/13/middleeast/jihadi-john-airstrike-target/.
[299] Aimal Faizi, "Drones Kill Any Chance of Peace in Afghanistan," *Al Jazeera*, June 29, 2015, http://www.aljazeera.com/indepth/opinion/2015/06/drones-kill-chance-peace-afghanistan-150628132016117.html.
[300] Michael R. Gordon and Eric Schmitt, "U.S. Said to Rebuff Iraqi Request to Strike Militants," *New York Times*, August 2, 2014, http://www.nytimes.com/2014/06/12/world/middleeast/iraq-asked-us-for-airstrikes-on-militants-officials-say.html?_r=0.
[301] Sarah Almukhtar and Karen Yourish, "More Than 14 Years After U.S. Invasion, the Taliban Control Large Parts of Afghanistan," *New York Times*, September 14, 2015, http://www.nytimes.com/interactive/2015/09/29/world/asia/afghanistan-taliban-maps.html?_r=0.

inability or unwillingness of the Iraqi central government to put an end to the sectarian strife, led to the solidification of power and territorial control of northern Iraq (and much of Syria) under the barbaric Islamic State.[302] U.S. drone policy in Afghanistan and Iraq has likely not endeared local civilian populations to the U.S. or for that matter, to their respective central governments, but it would be difficult to suggest that it is the primary or even a major contributor to the staying power of the Taliban in Afghanistan or the rise of the Islamic State in Iraq. The efficacy of U.S. drone policy in Afghanistan and Iraq, while still exceptionally capable of eliminating targeted forces in the short-term, might be unsustainable in the long-term, depending on the U.S. government's perceived foreign policy objectives for the respective countries.

Looking over the reported numbers and conditions spread across six countries in the Greater Middle East, it is worth discussing the perceived impact that drone strikes have had on militants and civilians and the long-term effects on the region as a whole. Drone strikes are as much a psychological weapon as they are a kinetic one, intended to strike fear into the hearts of terrorists everywhere by reciprocating the paranoiac fear of vulnerability that terrorists strike into the hearts of those they terrorize. As a psychological weapon against terrorists, drone strikes appear to have worked well, with even Osama bin Laden writing on their effect:

> I had mentioned in several previous messages ... the importance of the exit from Waziristan of the brother leaders, especially the ones that have media exposure. I stress this matter to you and that you choose distant locations to which to move them, away from aircraft, photography and bombardment while taking all security precautions. [303]

Yet the psychological effect is not limited to just terrorists, it spreads to the civilians and

[302] "The Rise of ISIS," *PBS*, October 28, 2014, http://www.pbs.org/wgbh/frontline/film/rise-of-isis/.
[303] Pam Benson, "Bin Laden Documents: Fear of Drones," *CNN*, May 3, 2012, http://security.blogs.cnn.com/2012/05/03/bin-laden-documents-fear-of-drones/.

communities around a target area, producing a mental health problem similar to anticipatory anxiety.[304] This unnerving fear caused by drones makes civilians refrain from assisting those wounded in drone strikes, militant or not, and from congregating in groups in places where militants are known to have been before. This state of paranoia breeds suspicion in communities, spreads anti-American rumors, and feeds the legitimacy of extremist views against a government that would allow its own citizens to experience such fear, valid or not.[305]

The acceptance of extremist views on the legitimacy of the government places domestic pressure on the ruling powers, which is then further compounded because U.S. drone policy actively undermines the authority of compliant governments.[306] A cornerstone of U.S. counterterrorism policy is to buildup stable, effective, and legitimate governments that will oppose radicalism and address the factors breeding militants, without the need for American intervention.[307] Yet in the process of carrying out drone strikes, the U.S. could be perceived as undermining the legitimacy of the government in the long-term for short-term capability or bolstering the host government policies which may have helped create the situation at the outset.[308] There are valid arguments to be made for using drone strikes over conventional airstrikes or ground forces, which is often as much a debate about policy as it is about efficacy. However, while the U.S. may choose to promote the argument for the effectiveness of drone strikes over conventional airstrikes or ground forces to eliminate militants and minimize civilian casualties, the

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[304] "The Costs and Consequences of Drone Warfare," p. 21-22.
[305] *Ibid.*
[306] "Reforming U.S. Drone Strike Policies," p. 9-11.
[307] "Fact Sheet: National Strategy for Counterterrorism."
[308] James Igoe Walsh, "The Effectiveness of Drone Strikes in Counterinsurgency and Counterterrorism Campaigns," *Strategic Studies Institute,* accessed June 11, 2016, http://www.strategicstudiesinstitute.army.mil/pdffiles/pub1167.pdf, p. 4.

numbers argument is rapidly lost on an already suspicious population.[309] This is to say nothing on the potential loss of American perception and prestige broadly in the Greater Middle East, which may suffer as a result of continued drone strikes at the objection of Middle Eastern governments.

So then what is the efficacy of U.S. drone warfare? At the very least the success or perception thereof of the U.S. drone program has fueled the development and proliferation of armed UAVs around the world. It has likely raised the risk of a global arms race to secure weaponized UAV capabilities by state and non-state actors, many of which may use them in ways unfavorable to U.S. policy objectives and interests. It would take no significant stretch of the imagination to consider what Russia could do with armed UAVs in its intervention in Syria or its hybrid war in the Ukraine, what China might do in its own restive western territories, what competing Middle Eastern states might proliferate to their religious proxies, or what al-Qaeda or the Islamic State could do with a competently armed UAV capability.

If we gauge the efficacy of U.S. drone policy strictly by the numbers, it would be hard to argue that U.S. drone strikes have been anything but a success for U.S. goals. Adding together the drone strike and casualty estimates cited earlier in this section, the estimated 1,713 reported drone strikes carried out by the U.S. government under the Bush and Obama administrations, has reportedly led to the death of at least 4,600 militants or a minimum average of 2.7 militants killed per strike. Following the same math and cited estimates, those same 1,713 reported strikes have reportedly killed nearly 1,249 civilians or persons of unknown affiliation at a minimum average of 1.4 civilians or persons killed per strike or 21.4% of all deaths from U.S. drone strikes. These reported numbers are next

[309] "The Costs and Consequences of Drone Warfare," p. 12-13.

to impossible to compare with how conventional airstrikes or ground troops would fare in the same situation; though they are likely better than the alternative, that fact is likely little solace to the families of those killed.

If we gauge the efficacy of U.S. drone policy by its capability to meet stated U.S. counterterrorism goals, it is more difficult to declare it an outright success. U.S. drone strikes have likely helped disrupt, degrade, dismantle, and defeat terrorists, eliminated terrorist safe havens, degraded the links between terrorist groups, and deprived terrorists of their enabling means, but U.S. drone strikes have not likely served to counter extremist ideologies and their attempts to justify violence. On the contrary, it is possible that U.S. drone policy may have only served to fuel the acceptance, growth, and tacit approval by locals towards the extremist ideologies that have fostered the very terrorists the U.S. drone strikes are meant to eliminate. This is to say nothing of the ambiguous impact that U.S. drone policy may have on U.S. foreign policy in the Greater Middle East for years, perhaps decades, to come. While it is difficult to gauge the overall efficacy of U.S. drone policy, it has likely been successful for our short-term counterterrorism objectives, but may not be a net positive for our long-term goals.

Chapter Summary

The development and deployment of unmanned systems highlighted above serves as the backdrop for much of the ongoing debate over LAWS at the UN CCW Meeting of Experts on LAWS. Arguments over terminology and historical lineage that serves to differentiate unmanned systems from other weapon systems play an increasingly larger role in trying to establish some common ground in the LAWS debate. The U.S.

development and deployment of unmanned systems has fostered a proliferation of the systems internationally over the last several years, particularly armed ones, that will undoubtedly set the stage for future developments. Finally, the continuing question over the efficacy of drone warfare has exacerbated tensions on the issue of unmanned systems, which serves to undermine meaningful discussion on the issue and colors public perception over the development of unmanned systems at large.

THE ARMS CONTROL LEGACY

After three years and as many meetings, several parties at the UN CCW Meeting of Experts on LAWS continue to voice support for an international prohibition on the development of LAWS. In their support for an international prohibition, proponents have pointed to previous arms control treaties and conventions as proof that the international community can make a ban on LAWS work. Protocol IV of the UN CCW is perhaps the most often cited analogous comparison of how the international community could prohibit the development and deployment of LAWS. Some activists also see the Ottawa Process that led to the Mine Ban Treaty as an alternative comparison, should efforts at the CCW fail to meet the desired goals of the prohibition. Still other prohibition proponents see a comparison to be made with the various arms control efforts aimed at weapons of mass destruction (WMD) and the similarities in the arguments against those weapons.

The Protocol on Blinding Laser Weapons

Protocol IV of the CCW, known as the Protocol on Blinding Laser Weapons, is considered a successful precedent by proponents of international arms control efforts that could inform how a prohibition on LAWS would develop. Human Rights Watch and Harvard's International Human Rights Clinic have issued a joint report suggesting Protocol IV is an example of how a preemptive ban on LAWS could work.[310] The report highlights five "areas of concern" expressed by opponents of both blinding lasers and LAWS: "concerns under the Martens Clause, threats to civilians, risks of proliferation,

[310] "Precedent for Preemption: The Ban on Blinding Lasers as a Model for a Killer Robots Prohibition."

the need to clarify the legal landscape, and protection of legitimate technology."[311] While the two groups acknowledge that there are major differences between the legal, technological, and scale issues surrounding blinding lasers and LAWS, they argue that this only further enhances the critical need for a ban on LAWS.[312]

Protocol IV only has four articles and is fairly short and simplistic in its language:[313]

- Article I: It is prohibited to employ laser weapons specifically designed, as their sole combat function or as one of their combat functions, to cause permanent blindness to unenhanced vision, that is to the naked eye or to the eye with corrective eyesight devices. The High Contracting Parties shall not transfer such weapons to any State or non-State entity.

- Article II: In the employment of laser systems, the High Contracting Parties shall take all feasible precautions to avoid the incidence of permanent blindness to unenhanced vision. Such precautions shall include training of their armed forces and other practical measures.

- Article III: Blinding as an incidental or collateral effect of the legitimate military employment of laser systems, including laser systems used against optical equipment, is not covered by the prohibition of this Protocol.

- Article IV: For the purpose of this protocol "permanent blindness" means irreversible and uncorrectable loss of vision which is seriously disabling with no prospect of recovery. Serious disability is equivalent to visual acuity of less than 20/200 Snellen measured using both eyes.

The current path being pursued by proponents towards a ban on LAWS is strikingly similar to the path that led to the implementation of Protocol IV. The governments of Sweden and Switzerland introduced a joint proposal at the 1986 International Conference of the Red Cross and again at the UN General Assembly in 1987, calling for a ban on laser weapons that could cause "instantaneous permanent

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[311] *Ibid.*
[312] *Ibid.*
[313] United Nations, "Protocol on Blinding Laser Weapons," *United Nations Office at Geneva,* accessed May 23, 2016, http://www.unog.ch/80256EDD006B8954/%28httpAssets%29/8463F2782F711A13C12571DE005BCF1A/$file/PROTOCOL+IV.pdf.

blindness."[314] Blinding laser weaponry were thought to be in the early stages of development at the time, but received a tepid response from states assumed to be developing the weapons and from an international community that viewed the potential of the weapons as more science fiction than science fact.[315] The International Committee of the Red Cross began its own inquiry into the proposal and convened four meeting of experts between 1989 and 1991 with a range of government and nongovernmental experts.[316] Experts opined that blinding laser weapons were a concern under the Martens Clause, would cause suffering to both combatants and civilians, were a proliferation risk due to ease in production, might not comply with international humanitarian law, and could harm meaningful development of the technology for legitimate purposes.[317] Despite a general consensus from the meeting of experts on blinding weapons about the dangers that the weapons could pose, there was little apparent appetite among states to act on a weapon system that did not yet exist. The International Committee of the Red Cross published a book entitled *Blinding Weapons* in 1993, which contained the reports from the four meeting of experts and appealed widely to the public conscious to motivate governments to pursue a ban on blinding laser weapons at the 1995 First Review Conference.[318]

In the lead up to the 1995 First Review Conference there were four meetings of

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[314] Johan Molander, "Getting Together to Ban the Use of Blinding Laser Weapons," *New York Times*, December 18, 1995, http://www.nytimes.com/1995/12/18/opinion/18iht-edmol.t.html.
[315] *Ibid.*
[316] Human Rights Watch, "Precedent for Preemption: The Ban on Blinding Lasers as a Model for a Killer Robots Prohibition," *Human Rights Watch*, November 8, 2015, https://www.hrw.org/news/2015/11/08/precedent-preemption-ban-blinding-lasers-model-killer-robots-prohibition.
[317] *Ibid.*
[318] International Committee of the Red Cross, "Blinding Weapons: Alarming Report on Laser Weapons," *International Committee of the Red Cross*, January 02, 1995, https://www.icrc.org/eng/resources/documents/misc/57jmce.htm.

the GGEs between 1993 and 1995, which saw both Sweden and the International Committee of the Red Cross submit proposals in the third meeting for a ban of blinding laser weapons.[319] During the fourth meeting of the GGEs, delegations negotiated a draft protocol to ban blinding laser weapons, which was met with concern by France and the UK over certain language used in the protocol and was opposed in its entirety by the U.S., which saw a new protocol as unnecessary.[320] The International Committee of the Red Cross, Human Rights Watch, and other nongovernmental organizations (NGOs) pursued an aggressive campaign in the lead up to the 1995 First Review Conference, highlighting development of various military laser systems that did not preclude their use as blinders or dazzlers.[321] The campaign led to increased public scrutiny of government positions and programs, particularly in the U.S. and China, which led many previously indifferent governments to move towards supporting the draft protocol.[322] Protocol IV was successfully negotiated between 25 September and 13 October 1995 at the First Review Conference, was issued by the UN on 13 October 1995, and entered into force on 30 July 1998.[323]

However, Protocol IV does have its limitations. Protocol IV only covers the use of permanently blinding lasers in international conflict, which the U.S. government advocated should be extended to include internal conflict as well.[324] Protocol IV also does not preclude the use of dazzlers, lasers which are supposed to only cause temporary

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[319] Louise Doswald-Beck, "New Protocol on Blinding Laser Weapons," *International Committee of the Red Cross*, October 13, 1995, https://www.icrc.org/eng/resources/documents/misc/57jn4y.htm.
[320] *Ibid.*
[321] *Ibid.*
[322] *Ibid.*
[323] *Ibid.*
[324] U.S. Department of Defense, "Article-by-Article Analysis of Protocol on Blinding Laser Weapons," *U.S. Department of Defense,* accessed July 14, 2016, http://www.acq.osd.mil/tc/treaties/ccwapl/artbyart_pro4.htm.

blindness or disorientation, which were developed by the U.S. military in the Iraq War and used against vehicles that ignored warnings at checkpoints.[325] Yet the attention brought to bear on the issue of blinding laser weapons, which led to the successful negotiation and implementation of Protocol IV to the CCW and the continued non-use of the weapons on the battlefield, is seen as a victory by proponents, which could be replicated for LAWS.[326]

The Mine Ban Treaty

The effort led by NGOs to combat the use of mines which ultimately culminated in the Mine Ban Treaty, also known as the Ottawa Treaty, is another international arms control effort highlighted by proponents of a prohibition of LAWS. In another joint report by Human Rights Watch and Harvard's International Human Rights Clinic the groups suggest that although the specific term of "meaningful human control" has not been used in international arms control treaties, the concept of human control has, citing the Mine Ban Treaty as precedence.[327] The report argues that "it is the element of human control that distinguishes command-detonated mines from the antipersonnel mines covered by the Mine Ban Treaty. The treaty's explicit prohibition of victim-activated mines reflects that they pose a greater threat to non-combatants than do command-detonated ones. It also demonstrates that states have objected to weapons that can operate and kill without human control."[328]

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[325] "Lasers used on Iraqi drivers who won't stop," *MSNBC,* May 18, 2006, http://www.nbcnews.com/id/12854973/ns/world_news-mideast_n_africa/t/lasers-used-iraqi-drivers-who-wont-stop/.
[326] "Precedent for Preemption: The Ban on Blinding Lasers as a Model for a Killer Robots Prohibition."
[327] "Killer Robots and the Concept of Meaningful Human Control."
[328] *Ibid.*

The Mine Ban Treaty, the full title of which is the Convention on the Prohibition of the Use, Stockpiling, Production and Transfer of Anti-Personnel Mines and on their Destruction, was drafted on 18 September 1997, opened to signatures on 3 December 1997, and entered into force on 1 March 1999 with 162 state parties having ratified or acceded to the treaty.[329] While the text of the Mine Ban Treaty is quite lengthy, there are a few major commitments that states undertake when they join the treaty:[330]

- Never use antipersonnel mines, nor to develop, produce, otherwise acquire, stockpile, retain or transfer them.
- Destroy mines in their stockpiles within four years.
- Clear all mined areas in their territory within 10 years.
- In mine-affected countries, conduct mine risk education and ensure the exclusion of civilians from mined areas.
- Provide assistance for the care and rehabilitation, and social and economic reintegration, of mine victims.
- Offer assistance to other States Parties, for example in providing for survivors or contributing to clearance programs.
- Adopt national implementation measures (such as national legislation) to ensure that the terms of the treaty are upheld in their territory.
- Report annually on progress in implementing the treaty.

Some activists have argued that should the current path being pursued by proponents of a prohibition on LAWS before the CCW fail to meet the desired goal that proponents should emulate the 'Ottawa Process' that led to the Mine Ban Treaty.[331]

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[329] United Nations, "Convention on the Prohibition of the Use, Stockpiling, Production and Transfer of Anti-Personnel Mines and on their Destruction," *United Nations,* accessed May 25, 2016, https://treaties.un.org/Pages/ViewDetails.aspx?src=TREATY&mtdsg_no=XXVI-5&chapter=26&lang=en.
[330] International Campaign to Ban Landmines, "Treaty Text," *International Campaign to Ban Landmines*, accessed May 25, 2016, http://www.icbl.org/en-gb/the-treaty/treaty-in-detail/treaty-text.aspx.
[331] Keith Wagstaff, "Jody Williams Helped Ban Landmines. Can She Stop Killer Robots?" *NBC News*, April 15, 2015, http://www.nbcnews.com/tech/tech-news/jody-williams-helped-ban-landmines-can-she-stop-killer-robots-n340661.

Protocol II of the CCW, as it was originally drafted in 1980, placed restrictions on the use of landmines, booby-traps, and other explosives devices, but was fairly limited in its reach, particularly applying only to international conflict between states. The continued use of anti-personnel landmines by countries in civil wars during the 1980s and at demilitarized zones like the 38th parallel between North and South Korea, led to criticism of the limited extent of Protocol II by NGOs, private citizens, and governments alike. The International Campaign to Ban Landmines was a coalition created in 1992 by six NGOs: Human Rights Watch, Medico International, Handicap International, Physicians for Human Rights, Vietnam Veterans of America Foundation and the Mines Advisory Group, that pooled their experience and expertise to push for a ban on anti-personnel mines.[332] In 1993 the International Campaign to Ban Landmines held the First International NGO Conference on Landmines in London which issued a report entitled *Landmines: A Deadly Legacy* and the U.S. State Department released its report entitled *Hidden Killers: The Global Problem with Uncleared Landmines*, which drew international attention to the problem and the upcoming 1995 First Review Conference of the CCW.[333] However, negotiators at the 1995 First Review Conference did not reach agreement on proposals to ban anti-personnel mines, suspending negotiations until 1996, which eventually led to the adoption of the "weak" amended Protocol II in April 1996.[334]

Frustrated with the lack of an outright ban on anti-personnel mines in the amended Protocol II of the CWW, the Ottawa Process was born out of disappointment by

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[332] International Campaign to Ban Landmines, "About Us," *International Campaign to Ban Landmines*, accessed May 25, 2016, http://www.icbl.org/en-gb/about-us/who-we-are/the-icbl.aspx.
[333] International Campaign to Ban Landmines, "Timeline of the International Campaign to Ban Landmines," *International Campaign to Ban Landmines,* accessed May 25, 2016, http://www.icbl.org/media/916929/icb009_chronology_a5_v4-pages.pdf, p. 3.
[334] *Ibid,* p. 6.

several smaller states and NGOs with the limited restrictions that Protocol II of the CCW placed upon anti-personnel mines.[335] In October 1996 Canada hosted a convention in Ottawa attended by 75 nation-states and numerous NGOs and other international organizations to promote negotiation of a separate treaty to ban anti-personnel landmines, beginning the Ottawa Process aimed at negotiating a treaty within a year.[336] An intense publicity campaign led by the International Campaign to Ban Landmines followed, which aimed to increase awareness among the citizenry of undecided or opposed nation-states in-order to pressure governments into signing the soon to be negotiated treaty.[337] Belgium hosted the follow-up to the Ottawa convention from 24-27 June 1997, The Brussels International Conference for a Total Global Ban on Anti-Personnel Mines, which led to 97 governments signing the Brussels Declaration calling for the formal negotiation of a comprehensive anti-personnel landmine ban treaty.[338] The follow-on Oslo Diplomatic Conference on a Total Global Ban on Anti-Personnel Mines, occurred from 1-18 September 1997, which negotiated the Mine Ban Treaty with 89 state parties adopting the treaty at the time.[339]

While the Mine Ban Treaty is lauded by activists as a successful campaign of concerned citizens, NGOs, and smaller nation-states' capability to lead negotiations to the conclusion of an international arms control treaty, it is not without its share of criticism. So far 35 states have not signed or ratified the treaty, including the U.S., Russia, China,

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[335] International Campaign to Ban Landmines, "Frequently Asked Questions," *International Campaign to Ban Landmines*, accessed May 25, 2016, http://www.icbl.org/en-gb/the-treaty/treaty-in-detail/frequently-asked-questions.aspx.
[336] "Timeline of the International Campaign to Ban Landmines," p. 6.
[337] *Ibid.*
[338] International Committee of the Red Cross, "Convention on the Prohibition of the Use, Stockpiling, Production and Transfer of Anti-Personnel Mines and on Their Destruction, 18 September 1997," *International Committee of the Red Cross*, accessed May 25, 2016, https://www.icrc.org/ihl/INTRO/580.
[339] *Ibid.*

India, Pakistan, Iran, Saudi Arabia, Egypt, Israel, and North and South Korea.[340] The U.S. has thus far chosen not to join the Mine Ban Treaty, though it does abide by the treaty's requirements, except on the Korean Peninsula.[341] The U.S. has long advocated for the continued use of "smart mines" that deactivate or self-destruct automatically after a limited time frame, having long since stopped using traditional persistent mines, on the Korean Peninsula because of its unique security environment.[342] Some states and non-state actors continue to have active minefields, produce new anti-personnel mines, or have actively mined new areas.[343] Several state parties to the treaty have discussed exiting the treaty, at either the national or international level, due to the needs of military necessity along contentious borders, such as Ukraine and Finland.[344] Continued opposition to the Mine Ban Treaty exists for various reasons, from those who feel that mines could be adequately restricted to responsible use, to those who believe the treaty does not go far enough and should have included anti-vehicle mines as well.[345] The criticisms aside, some proponents of a ban on LAWS see an alternative process, like the Ottawa Process that led to the Mine Ban Treaty, as another potential avenue to pursue.[346]

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[340] "Convention on the Prohibition of the Use, Stockpiling, Production and Transfer of Anti-Personnel Mines and on their Destruction."
[341] David Alexander, "U.S. says will abide by Mine Ban Treaty except on Korean Peninsula," *Reuters,* September 23, 2014, http://www.reuters.com/article/us-usa-defense-landmines-idUSKCN0HI1U920140923.
[342] *Ibid.*
[343] Ryan Lenora Brown, "Land Mines Could Be Almost Completely Gone Within a Decade, Experts Say," *The Christian Science Monitor*, October 20, 2014, http://www.csmonitor.com/World/Progress-Watch/2014/1020/Land-mines-could-be-almost-completely-gone-within-a-decade-experts-say.
[344] Bryan Bender, "Formerly a leader on land mine ban, Obama now balks," *Boston Globe*, June 22, 2014, https://www.bostonglobe.com/news/nation/2014/06/21/nearly-two-decades-after-leading-role-remains-sidelines-treaty-banning-landmines/oMeRDQjDB3W2vj4VtuYqWK/story.html.
[345] Emily Alpert, "Why hasn't the U.S. signed an international ban on land mines," *Los Angeles Times,* April 5, 2012, http://latimesblogs.latimes.com/world_now/2012/04/mine-treaty-us-ottawa-convention.html.
[346] "Jody Williams Helped Ban Landmines. Can She Stop Killer Robots?"

Weapons of Mass Destruction and Arms Control

Other proponents of a prohibition on LAWS have opined that perhaps the closest analogy in urgency and impact to the need to outright ban LAWS is that of weapons of mass destruction (WMD). To that end, LAWS have been repeatedly described as "the third revolution in warfare, after gunpowder and nuclear arms."[347] Arguments used in the debates for the Biological Weapons Convention (BWC), Chemical Weapons Convention (CWC), and in the enduring debates over nuclear weapons, strike a similar chord to the case that has been made again LAWS.

The BWC, the full title of which is the Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on their Destruction, is considered the first international arms control treaty that bans the development, production, and stockpiling of an entire category of WMD.[348] The BWC was opened for signature on 10 April 1972 and entered into force 26 March 1975, upon the deposit of 22 nation-states' instruments of ratification, with 174 state parties having ratified or acceded to the treaty.[349] The CWC, the full title of which is the Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on their Destruction, is considered a necessary follow up to the Geneva Protocol of 1925.[350] The CWC was adopted by the Conference on Disarmament

[347] "Open Letter on Autonomous Weapons."
[348] United Nations Office for Disarmament Affairs, "The Biological Weapons Convention," *United Nations Office for Disarmament Affairs,* accessed May 25, 2016, https://www.un.org/disarmament/wmd/bio/.
[349] United Nations, "Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on their Destruction," *United Nations,* accessed May 25, 2016, http://disarmament.un.org/treaties/t/bwc.
[350] Organisation for the Prohibition of Chemical Weapons, "Genesis and Historical Development," *Organisation for the Prohibition of Chemical Weapons,* accessed May 25, 2016, https://www.opcw.org/chemical-weapons-convention/genesis-and-historical-development/.

in Geneva on 3 September 1992 and opened for signatures on 13 January 1993.[351] The CWC went into force on 29 April 1997 after ratification by 65 nation-states, with 192 state parties having ratified or acceded to the treaty.[352]

Both the BWC and the CWC lay out the scope for a specific ban on two entire groups of weapons and encompass the full cycle of development, production, and acquisition or retention of the weapons, legal language a ban on LAWS would likely emulate. Much like a potential ban on LAWS, the BWC and CWC also deal with weapons that have legitimate peaceful civilian technology applications and numerous beneficial dual-use technologies. Activists argue that international efforts to ban chemical and biological weapons, along with the continuing debate over nuclear weapons, are motivated at least in part by concerns over violations of international humanitarian law and human rights that are comparable to the concerns held regarding LAWS.[353] While a human can decide on the timing and placement of an initial target in using chemical and biological weapons, the effects of these weapons after release are uncontrollable and can spread to cause unintended victims.[354] Chemical, biological, and nuclear weapons are viewed as causing unnecessary suffering and outside of perhaps a few isolated scenarios, are indiscriminate in nature to both combatants and noncombatants, which can be seen to violate principles of *jus in bello* and other international human rights laws.[355] It is also argued that LAWS, like nuclear weapons, would be in violation of the Martens Clause and raises the concern of a ban over more contemporary concepts such as *malum in se*

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[351] United Nations, "Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on their Destruction," *United Nations,* accessed May 25, 2016, https://treaties.un.org/Pages/ViewDetails.aspx?src=TREATY&mtdsg_no=XXVI-3&chapter=26&lang=en.
[352] *Ibid.*
[353] "Killer Robots and the Concept of Meaningful Human Control."
[354] *Ibid.*
[355] *Ibid.*

(evil in itself).[356]

Yet both the BWC and CWC suffer criticism over their lack of universality and enforcement measures. Only 174 nation-states have ratified or acceded to the BWC, 22 short of the 196 that may become members,[357] and 192 nation-states have ratified or acceded to the CWC, five short of the 197 that may become members.[358] While both the BWC and CWC allow complaints to be lodged with the UN Security Council, neither treaty prescribes concrete actions to be taken against violators of the respective treaties. The BWC also lacks a verification measure, which allowed the Soviet Union to continue a biological weapons program, Biopreparat, for decades after it ratified the BWC and has undermined confidence in the treaty.[359] Additionally, the alleged use of chemical weapons in the Syrian Civil War by the Syrian government and the Islamic State, may also serve to undermine confidence in the CWC as well.[360] Neither the BWC nor the CWC have been perfect or infallible in their efforts to prevent deceit or abuse, as a ban on LAWS might also reflect, yet it is the similar arguments over international humanitarian law and human rights that activists tend to laude in their debate over a ban on LAWS.[361]

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[356] Patrick Lin, "Do Killer Robots Violate Human Rights?" *The Atlantic*, April 20, 2015, http://www.theatlantic.com/technology/archive/2015/04/do-killer-robots-violate-human-rights/390033/.
[357] "Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on their Destruction."
[358] "Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on their Destruction."
[359] Jenni Rissanen, "The Biological Weapons Convention," *Nuclear Threat Initiative,* March 1, 2003, http://www.nti.org/analysis/articles/biological-weapons-convention/.
[360] Rebecca Hersman, "Syria's Toxic War: Chemical Weapons Are Undermining Deterrence and Nonproliferation," *War on the Rocks,* April 26, 2016, http://warontherocks.com/2016/04/syrias-toxic-war-chemical-weapons-are-undermining-deterrence-and-nonproliferation/.
[361] Bonnie Docherty, "Why We Need to Ban Killer Robots," *Human Rights Watch,* April 15, 2016, https://www.hrw.org/news/2016/04/15/why-we-need-ban-killer-robots.

Chapter Summary

It is important to take note of the processes and arguments highlighted above of previous international arms control efforts by proponents at the UN CCW Meeting of Experts on LAWS, as it emboldens claims by activists that international arms control can be successful to some degree. Much as was the case in crafting the language of previous arms control efforts, it is important that any potential prohibition on LAWS properly protect the beneficial applications of the technology from being negatively impacted by a ban.[362] Yet despite a general lack of consensus on more basic issues, the case for an international prohibition continues to be pushed forward by groups like Human Rights Watch, the Campaign to Stop Killer Robots, and the Women's International League for Peace and Freedom. The arguments made by activists pointing to the perceived successes of Protocol IV of the UN CCW, the Ottawa Process in negotiating the Mine Ban Treaty, and the cases made for bans of weapons of mass destruction, will likely continue to play out before the UN CCW 2016 Fifth Review Conference in December. It is important to remember these considerations, as the paper nears its conclusion and addresses the case for prohibition.

[362] "Precedent for Preemption: The Ban on Blinding Lasers as a Model for a Killer Robots Prohibition."

CONCLUSION: THE CASE FOR INTERNATIONAL PROHIBITION

In debating the issue at the UN CCW Meeting of Experts on LAWS, the case for an international prohibition has been ever present, but at times ill defined. In their support for an international prohibition, proponents have pointed to previous arms control treaties and conventions, as proof that the international community can make a ban on LAWS work. Still others, a smaller minority of opponents and skeptics, have voiced their opinion on why either such a prohibition on LAWS will not work or is unnecessary. Regardless of whether they support or oppose a ban on LAWS, both proponents and opponents agree that there are many issues and concerns surrounding the development and deployment of LAWS that need to be addressed before the systems are introduced. The culmination of the discourse and debate from the three previous Meeting of Experts on LAWS at Geneva, will be argued before the UN CCW's 2016 Fifth Review Conference in Geneva on 12-16 December 2016.

At the 2015 Meeting of Experts, the mandate for the 2016 meeting expanded to include an additional concern, that "the meeting of experts may agree by consensus on recommendations for further work for consideration by the 2016 Fifth Review Conference."[363] The 2016 Meeting of Experts agreed on a non-binding recommendation that the High Contracting Parties to the CCW should formally establish a Group of Government Experts (GGE) on LAWS at the 2016 Fifth Review Conference.[364] If the parties to the 2016 Fifth Review Conference endorse the recommendation, then the GGE

[363] "2016 Meeting of Experts on LAWS."
[364] Chris Ford and Chris Jenks, "The International Discussion Continues: 2016 CCW Experts Meeting on Lethal Autonomous Weapons," *Just Security*, April 20, 2016, https://www.justsecurity.org/30682/2016-ccw-experts-meeting-laws/.

on LAWS would meet in 2017 and 2018 to "explore and agree on possible recommendations on options related to emerging technologies in the area of LAWS."[365] The GGE on LAWS could theoretically offer up any number of recommendations to be taken up by the High Contracting Parties, from more meetings and more discussion on understanding LAWS to actual mechanisms to implement a ban on LAWS.[366] The UN CCW's 2016 Fifth Review Conference will set the stage for continued engagement at some level on the issue of LAWS, but to what end is unclear. Whatever measures come from the GGE will likely determine whether the ongoing effort in the CCW will satisfy the concerns of proponents or if they will resort to going outside the body to pursue a prohibition. The primary concluding question then, is whether the case has been made for the international community to move towards implementing a prohibition of LAWS at this time?

In order to answer that question, we must ask what an international prohibition on LAWS would look like? Beyond the general consensus statement that a ban on LAWS is needed and now, few proponent parties to the UN CCW Meeting of Experts on LAWS have actually put forward qualitative recommendations on the topic. One of the few proposed recommendations comes from the International Committee for Robot Arms Control in a May 2013 working paper, *Compliance Measures for an Autonomous Weapons Convention*.[367] State parties to the proposed "Autonomous Weapons Convention" would, among other things, pledge "not to develop, test, produce, stockpile, deploy, transfer, broker transfer, or use weapon systems capable of autonomous target selection

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[365] *Ibid.*
[366] *Ibid.*
[367] Mark Gubrud and Jürgen Altmann, "Compliance Measures for an Autonomous Weapons Convention," *International Committee for Robot Arms Control,* May 2013, http://icrac.net/wp-content/uploads/2016/03/Gubrud-Altmann_Compliance-Measures-AWC_ICRAC-WP2-2.pdf.

and engagement."[368] Compliance to the convention would be enforced by a treaty implementing organization that could "facilitate consultations, implement technical safeguards, and conduct inquiries and investigations when so mandated."[369] In-order to verify that LAWS were not being used by a state party to the convention, there would be a need for a technical evidence trail of sorts that would monitor and record a wide range and amount of data on any weapons system with autonomous capability, the logistics of which appear troubling.[370] However, rather than presently propose a qualitative recommendation for a prohibition on LAWS, many proponents have instead advised that previous efforts at arms control would inform the development of any effort to ban LAWS. Yet few reports to that end appear to adequately address the criticisms and implementation concerns that have surrounded the previous arms control efforts often lauded by proponents, such as Protocol IV of the CCW, the Mine Ban Treaty, and the BWC and CWC.

Indeed, the same issues of universality, implementation, and verification that have plagued those arms control efforts would undoubtedly also be a concern for any prohibition on LAWS. Kenneth Anderson and Matthew Waxman, writing for the Hoover Institute, opined that an international treaty regulating or prohibiting LAWS would have "little traction among those most likely to develop and use them" and even states inclined to support a ban "will find it difficult to reach agreement on scope or definitions because lethal autonomy will be introduced incrementally."[371] Even if broad acceptance and consensus could be reached, they argue there would still be "the collective action

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[368] *Ibid,* p. 3.
[369] *Ibid,* p. 3-4.
[370] *Ibid,* p. 6-7.
[371] "Law and Ethics for Autonomous Weapon Systems: Why a Ban Won't Work and How the Laws of War Can," p. 21.

problems of failure and defection that afflict all such treaty regimes, especially when dealing with dual-use (civilian and military) underlying technologies."[372] Author Erik Schechter echoes Anderson and Waxman's argument that such a prohibition would not work, stating that "what makes a machine autonomous is its software, and that is buried deep within the system. Trying to distinguish a robot from a drone is like guessing what the apps are on a stranger's smartphone by looking at its protective case."[373]

Yet questions continue to arise from the arguments that have been made. Should we ban LAWS? What makes LAWS so different from other weapons systems that a ban is necessary? Would a ban work? What would a ban look like? What systems would we ban? How would we implement and verify a ban? How would this affect legitimate development of autonomy and robotics? These examples are but a few of the many questions that are being raised, some of which currently have no good answer from either proponents or opponents. If the GGE on LAWS were to recommend concrete steps be taken towards a ban on LAWS, it would need to address these concerns and it appears at this point that the argument for such a ban does not provide the most thorough of answers on how to do so.

So has the case for an international prohibition of LAWS been adequately made by proponents or argued against by opponents? As the exchanges on the many issues and concerns surrounding the development and deployment of LAWS outlined above demonstrates, much of the debate on the issues surrounding LAWS and actual measures to implement such a prohibition are in their infancy. Both proponents and opponents to an international prohibition of LAWS will make their case, again, before the 2016 Fifth

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[372] *Ibid*.
[373] Erik Schechter, "In Defense of Killer Robots," *Wall Street Journal*, July 10, 2014, http://www.wsj.com/articles/erik-schechter-in-defense-of-killer-robots-1405035148.

Review Conference, where there will be a clear need for a better understanding of the issues surrounding LAWS and where it should become increasingly apparent that an acceptable level of consensus has not been reached on many of the concerns. It is important that the GGE on LAWS not rush to endorse recommendations for immediate action be taken to ban LAWS, but instead foster continued investigation of the issues. The international community is not, at this time, adequately prepared to implement a ban nor properly informed of the extent of the issues surrounding LAWS and should not rush to make a decision while the lead time on development currently permits further discourse.[374] Yet the reality of the situation will not likely stop proponents from continuing to push for the rapid implementation of a ban on LAWS and while it is important that they are continuing to raise perception of the issues surrounding LAWS, a ban at this time seems a bit premature.

The lack of consensus on many of the most basic issues is troubling, even more so considering the calls to implement a wide ranging prohibition despite the uncertainties and without a clear path forward on how such a ban would work. The push by proponents for a ban on LAWS as soon as possible, without clear agreement or understanding on many of the complexities surrounding the issue, has the potential to undermine the end result's implementation and verification. Before we are rushed headlong into an unrealistic or undesirable international agreement that will directly impacts our national interests, the U.S. government might advocate for more time to consider the issue and restraint by the international community in order to allow greater discourse on the issue to happen.

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[374] Michael Horrowitz, "Ban killer robots? How about defining them first," *Bulletin of the Atomic Scientists,* June 24, 2016, http://thebulletin.org/ban-killer-robots-how-about-defining-them-first9571.

There are a couple of ways that the U.S. government might encourage such a move. The U.S. DoD has already laid out a cautionary, but well formed, path forward on the development of unmanned systems and autonomy through DoD Directive 3000.09, *Autonomy in Weapon Systems*. Even proponents who view DoD Directive 3000.09 as a paltry first step welcome its "clear lines of responsibility for creating guidelines for system development, testing and evaluation, equipment/weapons training, as well as developing doctrine, tactics, techniques and procedures."[375] While proponents may chide the U.S. government because they believe DoD Directive 3000.09 does not go far enough, there is no reason why it should not be viewed as better than no guidance at all. Indeed, the U.S. is the only country that has done so thus far and there is little reason why the establishment of such national guiding documents internationally could not be one of the recommendations by the U.S. delegation to the GGE on LAWS.

Additionally, the U.S. delegation to the Meeting of Experts, supported by the British, Canadian, and German delegations, highlighted transparency measures and national legal reviews of new weapon systems in accordance with Article 36 of the Additional Protocol to the Geneva Convention as confidence building measures that parties to the CCW could undertake.[376] The first steps in a proposed transparency action plan highlighted in the 2015 Meeting of Experts included: "creation of a focal point at a national level in order to overcome the fragmentation of information at different national levels; establishment of a point of contact for the international exchange of information; increasing the frequency of interaction; and sharing information on a voluntary basis and

[375] Heather Roff, "Reigning in the Killer Robot? The DoD's Directive on Autonomous Weapons," *The Huffington Post,* June 16, 2013, http://www.huffingtonpost.com/heather-roff/reigning-in-the-killer-ro_b_3094675.html.
[376] "US Needs to Stop Tiptoeing Around the "Killer Robots" Threat."

making it widely available."[377] It was noted that while such transparency efforts would not constitute an overall solution, "it can be an important step and a precondition for further regulation" and would be useful in "deterring violations of regulations, exposing abuse, setting a positive precedent, fostering democratic legitimacy and promoting an informed public debate."[378] While some countries, such as China, India, and Russia, have opined that such measures are premature at this time, if the alternative is an outright ban of LAWS, there appears to be no reason why such measures could not be another recommendation put forward by the U.S. delegation to the GGE on LAWS.[379]

Steps like these increase the number of options available to the U.S. delegation to the GGE on LAWS, would foster confidence in the ongoing process, and encourage debate on the issues surrounding LAWS to continue. The U.S. government could encourage other countries at the 2016 Fifth Review Conference to pledge to support and implement similar policies in the international development of unmanned systems and autonomy, as an intermittent step, while the concerns surrounding LAWS are addressed. While the measures may be viewed as imperfect or unwarranted, there are few others being openly put forward at this time by other parties to the 2016 Fifth Review Conference, which the U.S. could capitalize on to help lead it in a favorable direction. It is important that the U.S. government help representatives to the 2016 Fifth Review Conference and the GGE to look beyond the hyperbole and not rush headlong into a prohibition until we better understand the complexities that surround the issue of LAWS.

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[377] United Nations, "Advanced Copy of the Report of the 2015 informal Meeting of Experts on Lethal Autonomous Weapons Systems (LAWS)," *United Nations*, accessed July 14, 2016, http://www.genf.diplo.de/contentblob/4567632/Daten/5648966/201504berichtexpertentreffenlaws.pdf, p. 25.
[378] *Ibid,* p. 24.
[379] Campaign to Stop Killer Robots, "Report on Activities," *Campaign to Stop Killer Robots,* June 4, 2015, http://www.stopkillerrobots.org/wp-content/uploads/2013/03/KRC_CCWx2015_Report_4June2015_uploaded.pdf, p. 20-21.

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