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INTERNATIONAL GOVERNANCE OF AUTONOMOUS MILITARY ROBOTS

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New technologies have always been a critical component of military strategy and preparedness. One new technology on the not-too-

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distant technological horizon is lethal autonomous robotics, which would consist of robotic weapons capable of exerting lethal force without human control or intervention. There are a number of operational and tactical factors that create incentives for the development of such lethal systems as the next step in the current development, deployment and use of autonomous systems in military forces. Yet, such robotic systems would raise a number of potential operational, policy, ethical and legal issues. This article summarizes the current status and incentives for the development of lethal autonomous robots, discusses some of the issues that would be raised by such systems, and calls for a national and international dialogue on appropriate governance of such systems *before* they are deployed. The article reviews potential modes of governance, ranging from ethical principles implemented through modifications or refinements of national policies, to changes in the law of war and rules of engagement, to international treaties or agreements, or to a variety of other "soft law" governance mechanisms.

I. INTRODUCTION

Military technology is a field driven by change – the constant pursuit to be better, faster, stronger. Certain technological achievements like guns and planes have happened in the purview of the public and have revolutionized the world of war as we know it. Yet many technological changes have occurred under the radar, in military labs and private test fields, with the majority of citizens unaware of the leaps and bounds of progress. Robotics is one such modern military technology advancement that has largely escaped public attention to date. Combining the most advanced electronic, computer, surveillance, and weapons technologies, the robots of today have extraordinary capabilities and are quickly changing the landscape of battle and dynamics of war. One of the most important achievements has been the creation of robots with autonomous decision-making capability.[2] In particular, the development of autonomous robots capable of exerting lethal force, known as lethal autonomous robots ("LARs"), has significant implications for the military and society.

A variety of never-before-anticipated, complex legal, ethical, and political issues have been created – issues in need of prompt attention and action. There have recently been growing calls for the potential risks and impacts of LARs to be considered and addressed in an anticipatory and preemptive manner. For example, in October 2010, a United Nations human-rights investigator recommended in a report to the United Nations that "[t]he international community urgently needs to address the legal, political, ethical and moral implications of the development of lethal robotic technologies."[3] In September 2010, a workshop of experts on unmanned military systems held in Berlin issued a statement (supported by a majority but not all of the participants) calling upon "the international community to commence a discussion about the pressing dangers that these systems pose to peace and international security and to civilians."[4] While there is much room for debate about what substantive policies and restrictions (if any) should apply to LARs, there is broad agreement that now is the time to discuss those issues. The recent controversy over unmanned aerial vehicles ("UAVs") that are nevertheless human-controlled (often referred to as "drones") demonstrates the importance of anticipating and trying to address in a proactive manner the concerns about the next generation of such weapons – autonomous, lethal robotics.[5]

This article seeks to provide a background of some of these issues and start the much needed legal and ethical dialogue related to the use of lethal autonomous robotic

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[2] *See generally* Ronald C. Arkin, Governing Lethal Behavior in Autonomous Robots (2009).

[3] Patrick Worsnip, *U.N. Official Calls for Study of Ethics, Legality of Unmanned Weapons,* Wash. Post, Oct. 24, 2010.

[4] The Statement of the 2010 Expert Workshop on Limiting Armed Tele-Operated and Autonomous Systems, Berlin, Sept. 22, 2010, *available at* http://www.icrac.co.cc/Expert%20Workshop%20Statement.pdf (last visited Nov. 14, 2010).

[5] P.W. Singer, *Military Robots and the Laws of War,* New Atlantis, Winter 2009, at 25, 43.

technologies in the military context. The next part (Part II) of this article provides a brief history and illustrations of autonomous robots in the military, including the pending development of LARs. Part III sets forth a number of important ethical and policy considerations regarding the use of robots in military endeavors. Part IV reviews the current patchwork of guidelines and policies that apply to the use of military robots. Part V considers the role that international treaties and agreements might play in the governance of LARs, while Part VI investigates the potential role of soft-law governance mechanisms such as codes of conduct.

II. BACKGROUND ON AUTONOMOUS MILITARY ROBOTICS

In the United States there has been a long tradition of applying innovative technology in the battlefield, which has often translated into military success.[6] The Department of Defense ("DOD") naturally extended this approach to robotics. Primary motivators for the use of intelligent robotic or unmanned systems in the battlefield include:

> *Force multiplication* – with robots, fewer soldiers are needed for a given mission, and an individual soldier can now do the job of what took many before.
> *Expanding the battle-space* – robots allow combat to be conducted over larger areas than was previously possible.
> *Extending the warfighter's reach* – robotics enable an individual soldier to act deeper into the battle-space by, for example, seeing farther or striking farther.
> *Casualty reduction* – robots permit removing soldiers from the most dangerous and life-threatening missions.

The initial generation of military robots generally operate under direct human control, such as the "drone" unmanned aerial vehicles being used by the U.S. military for unmanned air attacks in Pakistan, Afghanistan, and other theaters.[7] However, as robotics technology continues to advance, a number of factors are pushing many robotic military systems toward increased autonomy. One factor is that as robotic systems perform a larger and more central role in military operations, there is a need to have them to continue to function just as a human soldier would, if communication channels are disrupted. In addition, as the complexity and speed of these systems increase, it will be increasingly limiting and problematic for performance levels to have to interject relatively slow human decision-making into the process. As one commentator recently put it, "military systems (including weapons) now on the horizon will be too fast, too

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[6] Material from this section is derived with permission from Arkin, *supra* note 2.

[7] *See generally* Peter W. Singer, Wired for War (2009); Peter Bergen & Katherine Tiedemann, Revenge of the Drones: An Analysis of Drone Strikes in Pakistan, New America Foundation, Oct. 19, 2009, *available at* http://www.newamerica.net/publications/policy/revenge_of_the_drones (last visited Nov. 14, 2010).

small, too numerous, and will create an environment too complex for humans to direct."[8]

Based on these trends, many experts believe that autonomous, and in particular lethal autonomous, robots are an inevitable and relatively imminent development.[9] Indeed, several military robotic-automation systems already operate at the level where the human is still in charge and responsible for the deployment of lethal force, but not in a directly supervisory manner. Examples include: (i) the Phalanx system for Aegis-class cruisers in the Navy "capable of autonomously performing its own search, detect, evaluation, track, engage and kill assessment functions"[10] (Fig. 1); (ii) the MK-60 encapsulated torpedo (CAPTOR) sea mine system – one of the Navy's primary anti-submarine weapons capable of autonomously firing a torpedo and cruise missiles (Fig. 2); (iii) the Patriot anti-aircraft missile batteries; (iv) "fire and forget" missile systems generally; and (v) anti-personnel mines or alternatively other, more discriminating classes of mines (e.g., anti-tank).[11] These devices can each be considered to be robotic by some definitions, as they all are capable of sensing their environment and actuating, in these cases through the application of lethal force.

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[8] Thomas K. Adams, *Future Warfare and the Decline of Human Decisionmaking*, Parameters, U.S. Army War College Quarterly, Winter 2001-02, at 57-58.

[9] Arkin, *supra* note 2, at 7-10; *See generally* George Bekey, Autonomous Robots: From Biological Inspiration to Implementation and Control (2005); Robert Sparrow, *Building a Better WarBot: Ethical Issues in the Design of Unmanned Systems for Military Applications*, 15 Sci. Eng. Ethics 169, 173-74 (2009) [hereinafter Sparrow, *Building a Better Warbot*].

[10] U.S. Navy, "Phalanx Close-in Weapons Systems," United States Navy Factfile, *available at* http://www.navy.mil/navydata/fact_display.asp?cid=2100&tid=800&ct=2 (last visited Feb. 12, 2010).

[11] Antipersonnel mines have been banned by the Ottawa Treaty on antipersonnel mines, although the U.S., China, Russia, and thirty-four other nations are currently not party to that agreement. Convention on the Prohibition of the Use, Stockpiling, Production and Transfer of Anti-Personnel Mines and on their Destruction (Ottawa Treaty), Sept. 18, 1997, 2056 U.N.T.S. 211. Recent developments, however, indicate that the U.S. is evaluating whether to be a part of the Ottawa Treaty. *See* Mark Landler, *White House Is Being Pressed to Reverse Course and Join Land Mine Ban*, N.Y. Times, May 8, 2010, at A9.

Figure 1. Phalanx Close-in Weapons System (United States Navy Photograph)

Figure 2. Tomahawk Cruise Missile on Display (United States Navy Photograph)

In 2001, Congress issued a mandate that stated that by 2010 one-third of all U.S. deep-strike aircraft should be unmanned and by 2015 one-third of all ground vehicles should be likewise unmanned.[12] More recently, the United States Department of Defense ("DOD") issued in December 2007 an Unmanned Systems Roadmap spanning twenty-five years, reaching until 2032, that likewise anticipated and projected a major shift

[12] Adams, *supra* note 8, at 57-58.

toward greater reliance on unmanned vehicles in U.S. military operations.[13]

As early as the end of World War I, the precursors of autonomous unmanned weapons appeared in a project on unpiloted aircraft conducted by the U.S. Navy and the Sperry Gyroscope Company.[14] Multiple unmanned robotic systems are already being developed or are in use that employ lethal force such as the ARV (Armed Robotic Vehicle), a component of the Future Combat System ("FCS"); Predator UAVs (unmanned aerial vehicles) equipped with hellfire missiles, which have already been used in combat but under direct human supervision; and the development of an armed platform for use in the Korean Demilitarized Zone, to name a few.[15]

The TALON SWORDS platform (Fig. 3) developed by Foster-Miller/QinitiQ has already been put to test in Iraq and Afghanistan and is capable of carrying lethal weaponry (M240 or M249 machine guns, or a Barrett .50 Caliber rifle). Three of these platforms have already served for over a year in Iraq and as of April 2008 and were still in the field, contrary to some unfounded rumors.[16]

A newer version, referred to as MAARS (Modular Advanced Armed Robotic System), is ready to replace the earlier SWORDS platforms in the field. The newer robot can carry a 40mm grenade launcher or an M240B machine gun in addition to various non-lethal weapons. The President of QinitiQ stated the purpose of the robot is to "enhance the warfighter's capability and lethality, extend his situational awareness and provide all these capabilities across the spectrum of combat."[17]

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[13] U.S. Department of Defense, DOD Unmanned Systems Roadmap: 2007-2032 (2007), *available at* http://www.fas.org/irp/program/collect/usroadmap2007.pdf (last visited Sept. 21, 2010).

[14] Adams, *supra* note 8, at 57.

[15] *See* Arkin, *supra* note 2, at 10.

[16] Foster-Miller Inc., Products & Service: TALON Military Robots, EOD, SWORDS, and Hazmat Robots (2008), *available at* http://www.foster-miller.com/lemming.htm (last visited Feb. 10, 2010).

[17] QinetiQ, Press Release: QinitiQ North America Ships First MAARS Robot, June 5, 2008, *available at* http://www.qinetiq.com/home/newsroom/news_releases_homepage/2008/2nd_quarter/qinetiq_north_america0.html (last visited Feb.12, 2010).

Figure 3. Foster-Miller TALON SWORDS Robot
(Department of Defense Photograph)

It is interesting to note that soldiers have already surrendered to UAVs even when the aircraft has been unarmed. The first documented instance of this occurred during the 1991 Gulf War. An RQ-2A Pioneer UAV, used for battle damage assessment for shelling originating from the U.S.S. Wisconsin, was flying toward Faylaka Island, when several Iraqis hoisted makeshift white flags to surrender, thus avoiding another shelling from the battleship.[18] Anecdotally, most UAV units during this conflict experienced variations of attempts to surrender to the Pioneer. A logical assumption is that this trend will only increase as UAVs' direct-response ability and firepower increase.

The development of autonomous, lethal robotics raises questions regarding if and how these systems can conform as well or better than our soldiers with respect to adherence to the existing Laws of War. This is no simple task however. In the fog of war it is hard enough for a human to be able to effectively discriminate whether or not a target is legitimate. Fortunately for a variety of reasons, it may be anticipated, despite the current state of the art, that in the future autonomous robots may be able to perform better than humans under these conditions, for the following reasons:[19]

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[18] Rebecca Maksel, *Predators and Dragons*, Air & Space Magazine, July 1, 2008, *available at* http://www.airspacemag.com/history-of-flight/Predators_and_Dragons.html (last visited Sept. 21, 2010).

[19] Arkin, *supra* note 2, at 29-30.

- The ability to act conservatively: i.e., they do not need to protect themselves in cases of low certainty of target identification. Autonomous, armed robotic vehicles do not need to have self-preservation as a foremost drive, if at all. They can be used in a self-sacrificing manner if needed and appropriate without reservation by a commanding officer.
- The eventual development and use of a broad range of robotic sensors better equipped for battlefield observations than humans currently possess.
- They can be designed without emotions that cloud their judgment or result in anger and frustration with ongoing battlefield events. In addition, "[f]ear and hysteria are always latent in combat, often real, and they press us toward fearful measures."[20] Autonomous agents need not suffer similarly.
- Avoidance of the human, psychological problem of "scenario fulfillment" is possible, a factor believed partly contributing to the downing of an Iranian Airliner by the U.S.S. Vincennes in 1988.[21] This phenomenon leads to distortion or neglect of contradictory information in stressful situations, where humans use new incoming information in ways that only fit their preexisting belief patterns, a form of premature cognitive closure. Robots can be developed so that they are not vulnerable to such patterns of behavior.
- Robots can integrate more information from more sources far faster before responding with lethal force than a human possibly could in real time. These data can arise from multiple remote sensors and intelligence (including human) sources, as part of the Army's network-centric warfare concept and the concurrent development of the Global Information Grid.[22] "[M]ilitary systems (including weapons) now on the horizon will be too fast, too small, too numerous and will create environments too complex for humans to direct."[23]
- When working in a team of combined human soldiers and autonomous systems as an organic asset, they have the potential capability of independently and objectively monitoring ethical behavior in the battlefield by all parties and reporting infractions that might be observed. This presence alone might possibly lead to a reduction in human ethical infractions.

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[20] Michael Walzer, Just and Unjust Wars 251 (4th ed., 1977).

[21] Scott D. Sagan, *Rules of Engagement*, in Avoiding War: Problems of Crisis Management 443, 459-61 (Alexander L. George ed., 1991)

[22] DARPA (Defense Advanced Research Projects Agency), Broad Agency Announcement 07-52, *Scalable Network Monitoring*, Strategic Technology Office, Aug. 2007, *available at* .https://www.fbo.gov/index?s=opportunity&mode=form&tab=core&id=b524ff8d8f7390061d4c5d5444c9e620&tab=documents&tabmode=list (last visited Sept. 22, 2010).

[23] Adams, *supra* note 8, at 58.

The trend is clear: Warfare will continue and autonomous robots will ultimately be deployed in the conduct of warfare. The ethical and policy implications of this imminent development are discussed next, followed by a discussion of governance options.

III. ETHICAL AND POLICY ASPECTS

There are numerous ethical, policy, and legal issues relating to creation and deployment of lethal autonomous robots. Although an exhaustive list of these issues will not be offered here, a number of the key ones will be outlined. Rather than defending a particular point of view on the technology, the primary aim is to promote awareness of these issues and to encourage lawyers, policymakers, and other relevant stakeholders to consider what may be appropriate legal and regulatory responses to LARs as they are being developed.

A. Responsibility and Risks

Australian philosopher Robert Sparrow has been a prominent voice in debates about the ethics of lethal autonomous robots. For instance, he examines the complexities associated with assigning ethical and legal responsibility to someone, or something, if an autonomous robot commits a war crime.[24] He considers several possible solutions to this puzzle, including "the programmer," "the commanding officer," and "the machine" itself, but concludes that each option has its profound share of difficulties.[25] Remaining neutral on whether Sparrow is correct, assigning responsibility to a LAR's behavior (or misbehavior) is an important matter that warrants further investigation. Along related lines, Peter Asaro doubts whether a robot can be punished in a meaningful way since it is unlikely to possess any form of moral agency, observing that traditional notions from criminal law such as "rehabilitation" and "deterrence" do not seem applicable here.[26]

One of the principal justifications for relying on autonomous robots is that they would have access to a greater amount of information than any human soldier. Yet this advantage raises key questions, including whether a robot should ever be permitted to refuse an order and, if so, under what conditions. Refusing an order on the battlefield is of course a serious matter, but should a robot be given more latitude to do so than a human soldier?

Battlefield units containing human soldiers and LARs will raise additional ethical issues relating to risk and responsibility. According to Sparrow, "human beings will start

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[24] Robert Sparrow, *Killer Robots*, 24 J. Applied Phil. 66 (2007) [hereinafter Sparrow, *Killer Robots*].

[25] *Id.* at 69-73.

[26] Peter Asaro, Robots and Responsibility from a Legal Perspective, Proceedings of the IEEE 2007 International Conference on Robotics and Automation, Workshop on RoboEthics, April 14, 2007, Rome, Italy.

to be placed in harm's way as a result of the operations of robots."[27] But will soldiers genuinely be aware of the kinds of risks they are being exposed to when working with robotic counterparts? If not, Sparrow fears that soldiers might place too much trust in a machine, assuming, for example, it has completed its assigned tasks.[28] And even if soldiers are fully aware of the risks associated with reliance on robotics, how much additional risk exposure is justifiable?

B. Legal Status of Civilians

In any treatment of LARs, the question of potential liability to civilians must be considered. Civilians initially responsible for empowering or placement of LARs may not necessarily be absolved of legal responsibility should the LAR perform unintended consequences. For example, it is entirely possible that a failure to recognize and obey an attempt for surrender could invoke a violation of the Law of Armed Conflict ("LOAC"). If a civilian software writer failed to initially write code that recognized the right to surrender through a flag of truce or other means, then a "reach back" to civilian liability for the breach might be possible. Likewise, if the civilian software writer failed in attempts to program identifiable legally protected structures such as places of worship, hospitals, or civilian schools, the code writer may be subject to potential liability in those scenarios as well.

The use of smaller yet lethal robots is gaining acceptance in battlefield operations. It is entirely possible that a small three-foot or less autonomous robot might be thrown or "launched" into an open building or window with lethal gun-firing capabilities much like a whirling dervish.[29] Should this whirling dervish either not be programmed to accept, or fail to recognize, internationally established symbols of surrender such as a white flag, would the robot's responsible forces, probably including civilian software code writers, escape legal liability for these omissions?

Similarly, well-intentioned and seemingly complete software programming might go astray in other ways. Under Law of War concepts, and specifically the Hague Convention (Hague VIII), it is forbidden to lay unanchored automatic contact mines unless they will become harmless at one hour or less after the mines are no longer under

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[27] Sparrow, *Building a Better WarBot*, *supra* note 9, at 172.

[28] *Id.* at 172-73.

[29] For example, the TALON robot has been cited by its manufacturer for its extensive use in military operations in Afghanistan and Iraq. It is small and is capable of a variety of uses including the ability to deliver weapons fire. The manufacturer's web site specifically states that "TALON's multi-mission family of robots includes one specifically equipped for tactical scenarios frequently encountered by police SWAT units and MPs in all branches of the military. TALON SWAT/MP is a tactical robot that can be configured with a loudspeaker and audio receiver, night vision and thermal cameras and a choice of weapons for a lethal or less-than-lethal response". Qinetiq, TALON Robots – TALON SWAT/MP, *available at* http://www.qinetiq-na.com/Collateral/Documents/English-US/QDS09-049-TALON-SWAT-MP.pdf (last visited Feb. 28, 2010).

the control of the person (nation) who laid them.[30] If one examines unmanned vehicles, particularly unmanned under-water sea vehicles launched from a manned "mother ship," in the event that the mother ship becomes lost or disabled the unmanned "robotic" ship vehicle must, consistent with international navigational regulations and protocols, be able on its own to comply with the navigational regulations and responsibilities. No matter the degree of robotic autonomy, a legal responsibility is likely to exist for the actions of the un-tethered "loose" unmanned vehicle.

Consider the situation described by P.W. Singer in "Wired for War" in which a robot programmed to perform sentry work failed to identify a threatening action.[31] In that scenario in which a bar patron suffers from the hiccups, a robot trained to act as a sentry with accompanying lethal force could reasonably fail to identify the well-intentioned furtive hand gun gesture of the bartender so that the patron might be scared so as to lose the hiccups. If the robot sentry failed to identify this mimicked handgun gesture and mistakenly shot the bartender "thinking" a lethal threat existed, it is conceivable that the software writer of the code might be responsible for the mistaken actions.

The above examples illustrate how seemingly complete autonomous robotic systems may still pose legal liability issues upon the civilians initially responsible for their use within battle space operations. Amidst these scenarios, the civilian software code writer's work and ultimate responsibilities may enjoy a much longer and unanticipated legal life.

C. Complexity and Unpredictability

Unfortunately, a full awareness of the risks from autonomous robots may be impossible. Wallach and Allen discuss how predicting the relevant dangers can be fraught with uncertainty.[32] For example, a semi-autonomous anti-aircraft gun accidentally killed several South African soldiers.[33] Roger Clarke pointed out years ago that, "[c]omplex systems are prone to component failures and malfunctions, and to

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[30] The Law of War in conjunction with the laying of contact underwater mines is covered in Article I to the Hague Convention VIII; October 18, 1907. Article I states: "It is forbidden [] [t]o lay unanchored automatic contact mines, except when they are so constructed as to become harmless one hour at most after the person who laid them ceases to control them; [t]o lay anchored automatic contact mines which do not become harmless as soon as they have broken loose from their moorings; [and] [t]o use torpedoes which do not become harmless when they have missed their mark." Convention (VIII) Relative to the Laying of Automatic Submarine Contact Mines, Oct. 18, 1907, 36 U.S.T. 541.

[31] Singer, *supra* note 7, at 81.

[32] Wendell Wallach & Colin Allen, Moral Machines: Teaching Robots Right from Wrong 189-214 (2009).

[33] Noah Shachtman, *Robot Cannon Kills 9, Wounds 14*, Wired.com, Oct. 18, 2007, *available at* http://blog.wired.com/defense/2007/10/robot-cannon-ki.html (last visited Feb. 8, 2010).

intermodule inconsistencies and misunderstandings."[34] Blay Whitby echoes the notion by arguing that computer programs often do not behave as predictably as software programmers would hope.[35] Experts from computing, robotics, and other relevant communities need to continue weighing in on the matter so the reliability of LARs can be more thoroughly assessed.

Perhaps robot ethics has not received the attention it needs, given a common misconception that robots will do only what we have programmed them to do. Unfortunately, such a belief is sorely outdated, harking back to a time when computers were simpler and their programs could be written and understood by a single person. Now, programs with millions of lines of code are written by teams of programmers, none of whom knows the entire program; hence, no individual can predict the effect of a given command with absolute certainty, since portions of large programs may interact in unexpected, untested ways. Even straightforward, simple rules such as Asimov's Laws of Robotics can create unexpected dilemmas.[36] Furthermore, increasing complexity may lead to *emergent behaviors*, i.e., behaviors not programmed but arising out of sheer complexity.[37]

Related major research efforts also are being devoted to enabling robots to learn from experience. Learning may enable the robot to respond to novel situations, an apparent blessing given the impracticality and impossibility of predicting all eventualities on the designer's part. But this capability raises the question of whether it can be predicted with reasonable certainty *what* the robot will learn. Arguably, if a robot's behavior could be adequately predicted, the robot would just be programmed to behave in certain ways in the first place instead of requiring learning. Thus, unpredictability in the behavior of complex robots is a major source of worry, especially if robots are to operate in unstructured environments, rather than the carefully-structured domain of a factory or test laboratory.

D. Just-War Theory

An overarching concern is whether the use of LARs is consistent with time-honored principles, rules, and codes that guide military operations, including just-war theory, the Law of Armed Conflict ("LOAC"), and the Rules of Engagement. Scholars are already starting to analyze whether LARs will be capable of fulfilling the requirements of just-war theory. Noel Sharkey, for example, doubts that robots will be

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[34] Roger Clarke, *Asimov's Laws of Robotics: Implications for Information Technology-Part II*, 27 Computer 57, 65 (1994).

[35] Blay Whitby, *Computing Machinery and Morality*, 22 AI & Society 551, 551-563 (2008).

[36] Issac Asimov, I, Robot (1950).

[37] *See, e.g.*, Ray Kurzweil. The Age of Spiritual Machines: When Computers Exceed Human Intelligence (1999); Ray Kurzweil. The Singularity is Near: When Humans Transcend Biology (2005).

capable of upholding the principle of discrimination, which involves being able to distinguish between combatants and non-legitimate targets such as civilians and surrendering soldiers.[38] While discussing military robots and the principle of proportionality, Sparrow argues that "decisions about what constitutes a level of force *proportionate to the threat* posed by enemy forces are extremely complex and context dependent and it is seemingly unlikely that machines will be able to make these decisions reliably for the foreseeable future."[39] However, at this point, it remains an open question whether the differences between LARs and existing military technology are significant enough to bar the former's use.

Further, Asaro examines whether military robots may actually encourage wars by altering pre-conflict proportionality calculations and last resort efforts.[40] A fundamental impediment to war is the loss of human life, especially the lives of fellow citizens; casualties are a significant reason why wars are not more common. Sending an army of machines to war—rather than friends and relatives—may not exact the same physical and emotional toll on a population.[41] Assuming the existence of a just cause, one could celebrate this new calculus, which more readily permits legitimate self-defense. However, this reduced cost may, in turn, reduce the rigor with which non-violent alternatives are pursued and thus encourage unnecessary—and therefore unjust—wars. While this possible moral hazard obviously does not require us to maximize war costs, it does require efforts to inform and monitor national security decision-makers.

Finally, Singer suggests that these LARs weapons could undermine counterinsurgency efforts, where indigenous respect and trust is crucial to creating a reasonable chance of success.[42] Unmanned weapons may be perceived as indicative of flawed characters and/or tepid commitments, and are incapable of developing necessary personal relationships with local citizens. And even if remote controlled or autonomous weapons are more discriminate than soldiers, they are commonly perceived as less so.

E. Civilian Applications

Technology developed for military purposes frequently has civilian applications and vice versa. For instance, Singer notes how the REMUS, the Remote Environmental

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[38] Noel Sharkey, *Cassandra or False Prophet of Doom: AI Robots and War*, 23(4) IEEE Intelligent Systems 14, 16-17 (2008); Noel Sharkey, *The Ethical Frontiers of Robotics*, 32 Science 1800, 1800-01 (2008) ("[N]o computational system can discriminate between combatants and innocents in a close-contact encounter").

[39] Sparrow, *Building a Better WarBot*, *supra* note 9, at 178.

[40] Peter Asaro, *How Just Could a Robot War Be?*, in Adam Briggle, Katinka Waelbers, and Philip Brey (eds.), Current Issues in Computing and Philosophy 1, 7-9 (2008).

[41] Robert Sparrow, *Predators or Plowshares? Arms Control of Robotic Weapons*, IEEE Tech. Soc'y Magazine, Spring 2009, at 25, 26 (hereinafter "*Sparrow, Predators or Plowshares?*").

[42] Singer, *supra* note 7, at 299.

Monitoring Unit, was originally used by oceanographers but later an altered version of it was deployed in Iraq.[43] Further, many federal and state agencies have sought permission to use military technology such as UAVs.[44] Consequently, once LARs are developed for military use, what might the implications be down the road for their use in civilian contexts?[45]

F. Broader Ethical and Social Considerations

Any decisions and policies regarding military development and use of LARs will impact, and be impacted by, broader technological and social considerations.[46] The failure to acknowledge these considerations upfront, and include them in the analysis, can lead to dysfunctional results, and unnecessary failure of legal and policy initiatives. Accordingly, we will highlight some relevant considerations, and their potential implications.

Consider first what an LAR actually is: one of many potential functions platformed on a generic technology base, which itself may be highly variable. Thus, a "lethal" function, such as a repeating kinetic weapon mounted on a robotic system, is one that is intentionally programmed to identify, verify, and eliminate a human target. At other times, the same basic robotic system might be fitted for cargo carrying capacity, for surveillance, or for many other functions, either in a military or a civil capacity. "Autonomous" means that the platform is capable of making the necessary decisions on its own, without intervention from a human. This, again, may involve the lethality function, or it may not: one might, for example, tell a cargo robot to find the best way to a particular destination, and simply let it go.[47]

Similarly, "robot" may sound obvious, but it is not. Tracked machines such as the Talon or PackBot, or UAVs such as the Predator or Raven, are fairly obvious robotic technologies, but what about "smart" land mines that are inert until they sense the proper

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[43] *Id.* at 37-38.

[44] Anne Broache, *Police Agencies Push for Drone Sky Patrols*, CNET News, Aug. 9, 2007, *available at* http://news.cnet.com/Police-agencies-push-for-drone-sky-patrols/2100-11397_3-6201789.html (last visited Feb. 12, 2010).

[45] *See generally* Gary Marchant and Lyn Gulley, *National Security Neuroscience and the Reverse Dual-Use Dilemma*, 1 Am. J. Bioethics Neuroscience 20, 20-22 (2010).

[46] This consideration led the Lincoln Center for Applied Ethics at Arizona State University, the Inamori International Center for Ethics and Excellence at Case Western Reserve University, and the U.S. Naval Academy Stockdale Center for Ethical Leadership to found the Consortium for Emerging Technology, Military Operations, and National Security, or CETMONS. *See* CETMONS, http://cetmons.org (last visited June 17, 2010). *See generally also* Max Boot, War Made New (2006); John Keegan, A History of Warfare (1993).

[47] *See, e.g.*, DARPA, http://www.darpa.mil/grandchallenge/index.asp (last visited June 17, 2010), detailing the progress in autonomous vehicles as a result of DARPA's Grand Challenge initiative.

triggering conditions and are capable of jumping, or exploding, or doing whatever else they are built to do?[48] What about bombs that, once deployed, glide above the battlefield until finding an enemy target, which are then attacked while sparing cars, buses, and homes?[49] And what about a grid of surveillance/attack cybersects (insect size robots or cyborgs consisting of biological insects with robotic functions integrated into them)? Each cybersect taken alone may be too insignificant and dumb to be considered a robot, but the cybersect grid as a whole may actually be quite intelligent.[50] Going one step further, what should we call a weapons platform that is wirelessly connected directly into a remote human brain (in recent experiments, a monkey at Duke University with a chip implanted in its brain that wirelessly connected it to a robot in Japan kept the Japanese robot running by thought, so that the robot was in essence an extension of its own physicality)?[51] Even now, the Aegis computer fire control system deployed on Navy vessels comes with four settings: "semiautomatic", where humans retain control over the firing decision; "automatic special," where humans set the priorities but Aegis determines how to carry the priorities out; "automatic," where humans are kept in the loop but the system works without their input; and "casualty" where the system does what it thinks necessary to save the ship.[52]

This brief digression raises serious questions about what an LAR actually is. Certainly, it has a technology component, but in some ways this is almost trivial compared to its social, political, ethical, and cultural dimensions. In fact, one might well argue that in many important ways a LAR is more of a cultural construct than a technology, with its meaningful dimension being intent rather than the technology system.[53] This is an important point, for it suggests that any legal or regulatory approach that focuses on technology may be misplaced; conversely, it means that the underlying technologies which come together in an LAR will continue to evolve independent or irrespective of any direct controls on LARs – including the functionality of the physical hardware, the sophistication of the software, and the integrated technological capability

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[48] *See, e.g.*, Dynamic Networking and Smart Sensing Enable Next-Generation Landmines, http://www.computer.org/portal/web/csdl/doi/10.1109/MPRV.2004.4 (last visited June 17, 2010).

[49] *See, e.g.*, *The Calibration of Destruction*, The Economist, Jan. 30, 2010, at 87, 87-88.

[50] Gary Kitchener, *Pentagon Plans Cyber-Insect Army*, BBC News, Mar. 16, 2006, http://news.bbc.co.uk/2/hi/americas/4808342.stm, last visited June 17, 2010.

[51] *See, e.g.*, K. C. Jones, *Monkey Brains in U. S. Make Robot Walk in Japan*, InformationWeek, Jan. 16, 2008, *available at* http://www.informationweek.com/news/personal_tech/showArticle.jhtml?articleID=205801020, last visited June 18, 2010.

[52] *See, e.g.*, Singer, *supra* note 7, at 124-25.

[53] Similarly, commercial jets were understood to be transportation technologies until reconceptualized by Al-Qaeda terrorists into a weapon. Many individuals, not just engineers, underestimate the social and cultural dimensions of technology. *See, e.g.,* Wiebe Bijker, Thomas P. Hughes & Trevor Pinch (eds.), The Social Construction of Technological Systems (1997).

we call "autonomy."

It is because the technologies are separate from the use that the discussion of LARs is frequently confused: LARs are often discussed as if they were a "military technology," when in fact they are a set of technologies that can be integrated in ways that are effective and desirable given current military conditions. Let us begin by identifying two levels at which technologies function: Level I, or the shop floor level; and Level II, or the institutional and social system level.[54] Thus, for example, if one gives a vaccine to a child to prevent her from getting a particular disease, one is dealing with a Level I technology system: the desired goal, no disease, is inherent in use of the technology. On the other hand, if one starts a vaccine program in a developing country in order to encourage economic growth because of better health, it is a Level II system: use of vaccines may contribute to such a goal, but there are many intervening systems, pressures, policies, and institutions.

To return to LARs, then, one might begin by asking why deploy such a technology in any form? Here, one has serious coupling between Level I and Level II issues. The immediate Level I response is that deployment of LARs would save soldiers' lives on the side that deployed them; many explosive devices in Iraq and Afghanistan that might otherwise have killed and maimed soldiers have been identified, and eliminated, by robots. But this is in some ways only begging a serious Level II question. In World War I, for example, generals thought little of killing 100,000 men at a go by sending them into the teeth of concentrated machine gun fire. Consequently, simply avoiding casualties is an inadequate explanation. That world, however, has changed, especially for the U.S. military, which faces a particularly stark dilemma. It is charged by its citizens with being able to project force anywhere around the world, under virtually any conditions. But, for a number of reasons, American civilians have become increasingly averse to any casualties. So the U. S. military finds itself in the dilemma of being required to project its power without American soldiers dying. Additionally, the long-term demographics are not good: Americans, like other developed countries, are looking at an aging demographic, with the immediate implication that there are fewer young people to fill boots on the ground.[55]

The institutional and social context of military operations for the United States is increasingly one where better military productivity becomes paramount, with productivity measured as mission accomplishment per soldier lost. And robots can potentially contribute significantly to achieving such productivity. It's not just about saving soldier's lives, a Level I technology. It's also about building the capability to continue to project power with fewer casualties, and to do so because culture and society are changing to make fatalities, whether soldier or civilian, less acceptable, which are Level II trends.

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[54] The analysis of technology systems also includes Level III, the earth systems level; *see* Braden R. Allenby, *Earth Systems Engineering and Management: A Manifesto*, 41 Envtl. Sci. & Tech. 7960, 7960-66 (2007).

[55] *See* Noel Shachtman, *Army Looks to Keep Troops Forever Young*, Wired Danger Room, Apr. 24, 2009, http://www.wired.com/dangerroom/2009/04/army-looks-to-keep-troops-forever-young/ (last visited April 26, 2009).

In sum, LARs raise a broad range of complex ethical and social issues, which we have only begun to address here. Suffice it to say, though, that any attempt to regulate or govern such technology systems must address these issues in addition to the more concrete technological and legal issues. The various models available to attempt this task are discussed in the following sections.

IV. EXISTING GOVERNANCE MECHANISMS FOR MILITARY ROBOTS

At present, there are no laws or treaties specifically pertaining to restrictions or governance of military robots, unmanned platforms, or other technologies currently under consideration within the purview of this article. Instead, aspects of these new military technologies are covered piecemeal (if at all) by a patchwork of legislation pertaining to projection of force under international law; treaties or conventions pertaining to specific technologies and practices; international humanitarian law; and interpretations of existing principles of the Law of Armed Conflict (LOAC).[56]

There are, for example, multiple conventions in international law which purport to deal with specific technologies and practices, such as agreements pertaining to biological weapons,[57] chemical weapons,[58] certain types of ammunition,[59] the hostile use of environmental modification,[60] land mines,[61] incendiary weapons,[62] blinding laser

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[56] *See generally* Stephen E. White, *Brave New World: Neurowarfare and the Limits of International Humanitarian Law*, 41 Cornell Int'l L.J. 177 (2008); Mark Edward Peterson, *The UAV and the Current and Future Regulatory Construct for Integration into the National Airspace System*, 71 J. Air L. & Com. 521 (2006); Geoffrey S. Corn, *Unarmed but How Dangerous? Civilian Augmentees, the Law of Armed Conflict, and the Search for a More Effective Test for Permissible Civilian Battlefield Functions*, 2 J. Nat'l Sec. L.& Pol'y 257 (2008); Andrew H. Henderson, *Murky Waters: The Legal Status of Unmanned Undersea Vehicles*, 53 Naval L. Rev. 55 (2006); Jason Borenstein, *The Ethics of Autonomous Military Robots,* 2 Studies in Ethics, Law & Tech. Issue 1, Article 2 (2008); John J. Klein, *The Problematic Nexus: Where Unmanned Combat Air Vehicles and the Law of Armed Conflict Meet*, Air & Space Power J., Chronicles Online J. (2003), *available at* http://www.airpower.maxwell.af.mil/airchronicles/cc/klein.html (last visited Oct. 1, 2010); Anthony J. Lazarski, *Legal Implications of the Uninhabited Combat Aerial Vehicle—Focus: Unmanned Aerial Vehicles*, 16 Aerospace Power J. 74 (2002).

[57] Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and or their Destruction, Apr. 10, 1972, 26 U.S.T. 583, 1015 U.N.T.S. 163.

[58] Convention on the Prohibition of the Development, Production, Stockpiling and use of Chemical Weapons and on Their Destruction, Jan. 13, 1993, 1974 U.N.T.S. 45.

[59] The 1999 Hague Declaration Concerning Expanding Bullets, July 29, 1899, 1. Am. J. Int'l L. 157-59 (Supp.).

[60] Convention on the Prohibition of Military or Any Hostile Use of Environmental Modification Techniques, May 18, 1977, 31 U.S.T. 333, 1108 U.N.T.S. 151.

[61] Protocol on Prohibitions or Restrictions on the Use of Mines, Booby-Traps and Other

weapons,[63] and numerous others.[64] The United States is not a party to all of these conventions, and to the extent their requirements do not rise to the level of customary international law, the United States is not specifically bound by them. On the other hand, the United States has taken considerable interest in the articulation of standards which purport to regulate conduct generally on the battlefield, including how weapons are used. Thus, while no international agreements specifically regulate the use of LARs today, it is possible that such agreements might be negotiated and implemented in the future, as discussed later in this article.

In the interim, it bears mention that there are a variety of other potential existing constraints found in military doctrines, professional ethical codes, and public "watch-dog" activities (as well as in international law) that might pertain to the present governance dilemma regarding military robotics. These constraints, generally, were created to address a variety of issues which are not wholly consistent with or applicable to the challenges created by the development and use of robots for military and security purposes. Yet, their existence does provide an architecture upon which to build a system of governance regarding the military use of robots on the battlefield.

As we contemplate employing this existing architecture toward the governance of military robotics, it bears noting that governance systems that are successful in obtaining compliance with a particular policy, rule, or directive share a number of important characteristics. Successful systems of "good governance" involve *clearly defined and articulated* expectations*:* that is, they identify the precise problems to be solved, changes to be made, or goals to be sought through governance in straightforward terms. The solutions proposed to these problems, moreover, are *realistic*: that is, they do not attempt to articulate ideal norms of what *ought* to be, but rather provide feasible norms describing what *can*, in fact, be accomplished, under existing political, cultural and legal constraints. Successful systems of governance, moreover, are *holistic and inclusive*, in the sense that all stakeholders are identified and involved in some fashion in making the rules. Finally, they issue rules or principles that are *subject to assessment*: that is, the results are capable of measurement and evaluation of effectiveness, in a manner that allows for

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Devices (Protocol II), 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, May 3, 1996, 2048 U.N.T.S. 133; Convention on the Prohibition of the Use, Stockpiling, Production and Transfer of Anti-Personnel Mines and on their Destruction, Sept. 18, 1997, 2056 U.N.T.S. 211.

[62] Protocol on Prohibitions or Restrictions on the Use of Incendiary Weapons (Protocol III), 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, Oct. 10, 1980, 1342 U.N.T.S. 171.

[63] Protocol on Blinding Laser Weapons (Protocol IV), 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, Oct. 13, 1995, 35 I.L.M. 1218.

[64] *See generally* International Committee of the Red Cross, *International Humanitarian Law - Treaties & Documents*, *available at* http://www.icrc.org/ihl.nsf/TOPICS?OpenView (last visited Nov. 3, 2009).

subsequent amendment and improvement of the requirements when appropriate.[65]

If these principles of good governance are not adhered to, expectations and pronouncements often go unheeded. In light of these canons of best practice for good governance, we argue that the goal of technological innovation governance should be to insure that all technological innovation is accomplished within the framework of a culture that respects the long-term effects of such work, while considering, insofar as possible, the likely ramifications of the proposed innovation and development. Appropriate governance should also insure that future end-users or consumers of the specified technological innovations are aware of those ramifications, ideally in the design phase, but at very least well before development or application of the innovations in question. All this should be accomplished, moreover, without placing too heavy of a legislative hand on, nor otherwise discouraging, the creative and competitive energies that generate much-needed innovation.

Measured against the foregoing standards, contemporary governance architecture regarding the innovation and use of military robots would appear wholly inadequate to the task. And yet, there is considerable professional, national and international infrastructure upon which to hang a regime of articulated goals and proscriptions.

At the professional level, for example, there are multiple codes for ethical guidance regarding both best practices and limits on acceptable professional practice for a wide range of academic and professional disciplines. These ethical codes might conceivably find themselves applied in innovation in the field of robotics, especially for participants from professions such as engineering, computer science, biology, medicine, law, and psychology. As a general rule, these ethical codes or guidelines for professional practice are grounded in the traditional responsibilities of their individual professions, and do not contemplate the challenges which can be said to presently exist for innovation generally, or within the field of robotics specifically. Professions, for example, are often regulated at the state level based upon varying degrees of oversight by private organizations and societies. Those codes speak primarily to issues of the professional's relationship and responsibilities toward clients and customers, as well as toward likely competitors; they likewise address important moral and legal issues such as privacy, intellectual property, and education, but often lack any concrete obligations relating to broader social responsibilities for technology development.[66]

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[65] There has been a good deal of discussion in recent years about the subject of good governance, especially in the development area. The United Nations, for example, lists eight characteristics of good governance, which are: consensus oriented, participatory, adherence to the rule of law, effect and efficient, accountable, transparent, responsive, equitable and inclusive. United Nations Economic and Social Commission for Asia and the Pacific, *What is Good Governance?,* United Nations, 2009, *available at* http://www.unescap.org/pdd/prs/ProjectActivities/Ongoing/gg/governance.asp (last visited Oct. 4, 2010). *See also* Sam Agere, Good Governance, Promotion of Good Governance Principles, Practices and Perspectives (2000).

[66] A general review of various professional codes of ethics reveals a paucity of information which might be considered relevant to innovators of new technologies and practices. The American Psychological Association Code of Ethics is intended to protect "the welfare and protection of the individuals and groups with whom psychologists work" and to "improve the

Some of these internal ethical codes also appear to contemplate the future contexts in which professionals will have to operate. For example, a "Pledge of Ethical Conduct" printed in the commencement program for the College of Engineering at the University of California, Berkley in May 1998, reads:

> I promise to work for a BETTER WORLD where science and technology are used in socially responsible ways. I will not use my EDUCATION for any purpose intended to harm human beings or the environment. Throughout my career, I will consider the ETHICAL implications of my work before I take ACTION. While the demands placed upon me may be great, I sign this declaration because I recognize that INDIVIDUAL RESPONSIBILITY is the first step on the path to PEACE.[67]

To date, the most relevant initiative relating to the ethics of military technologies such as robotics is a "Code of Ethics" for robots being proposed by the Republic of South Korea (although the terms of the Code have yet to be fleshed out).[68] The main focus of

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condition of individuals, organizations, and society." American Psychological Association, Ethical Principles of Psychologists and Code of Conduct, 2010 Amendments, Preamble, *available at* http://www.apa.org/ethics/code/index.aspx (last visited Oct. 4, 2010). Psychologists are instructed to "strive to benefit those with whom they work and take care to do no harm," although this is stated as a general principle that is aspirational and non-enforceable. *Id*., Principle A. The American Medical Association provides nine principles which "…define the essentials of honorable behavior for the physician." American Medical Association, AMA Code of Medical Ethics, Principles of Medical Ethics (2001), *available at* http://www.ama-assn.org/ama/pub/physician-resources/medical-ethics/code-medical-ethics/principles-medical-ethics.shtml (last visited Oct. 4, 2010). Interestingly, the principles do not contain the traditional *do no harm* proscription but do require the provision of competent medical care "…with compassion and respect for human dignity and rights." *Id.*, Principle I. In most cases, except emergencies, physicians retain the right to "…choose whom to serve, with whom to associate, and the environment in which to provide medical care." *Id.*, Principle VI. The American Society of Civil Engineers requires engineers to "…hold paramount the safety, health and welfare of the public" and to "…strive to comply with the principles of sustainable development in the performance of their professional duties." American Society of Civil Engineers, Code of Ethics, *available at* http://www.asce.org/inside/inside/codeofethics.cfm, (last visited Nov. 24, 2009). A private professional association, the Information Systems Audit and Control Association (ISACA), which purports to serve 'IT governance professionals' requires their members to "…support the implementation of, and encourage compliance with, appropriate standards, procedures and controls for information systems." Information Systems Audit and Control Association, ISACA Code of Professional Ethics, *available at* http://www.isaca.org/Certification/Code-of-Professional-Ethics/Pages/default.aspx (last visited Nov. 25, 2009).

[67] University of California, Berkley, Pledge of Ethical Conduct (1998), *available at* http://courses.cs.vt.edu/cs3604/lib/WorldCodes/Pledge.html (last visited Jan. 15, 2010).

[68] Republic of Korea, Ministry of Information and Communication *quoted in* Stefan Lovgren, *Robot Code of Ethics to Prevent Android Abuse, Protect Humans*, National Geographic News, Mar. 16, 2007, *available at* http://news.nationalgeographic.com/news/2007/03/070316-

the charter appears to deal with social problems, such as human control over robots and humans becoming addicted to robot interaction (e.g., using robots as sex toys).[69] The document will purportedly deal with legal issues, such as the protection of data acquired by robots and establishing clear identification and traceability of the machines.[70]

These internal professional codes and norms are complemented by a host of non-governmental organizations ("NGOs") which contribute to the transparency of innovation programs, especially those performed on behalf of the State. The goals and agendas of these organizations are as varied as their names, but their methodologies generally help to educate the end-user or consumer about what is being developed and what the future may portend. Such NGOs often succeed in establishing a record of evidence and impact regarding a particular thread of innovation, placing this evidence before the public and state funders (legislatures, policy-makers, and appropriate government agencies), and providing news media with the expertise to report on the likely ramifications of proposed technological innovations.[71] An NGO specifically focused on promoting arms control for military robots has recently been formed, called the International Committee for Robot Arms Control ("ICRAC").[72]

At the national level in the United States, existing governance can be described as *decentralized,* and in one sense, *reactionary.* It reflects the *push* and *pull* of multiple constituencies and philosophies regarding the efficacy of support for technological innovation. U.S. federal law and regulation reflect the belief that innovation is best encouraged on the one hand by vigorous and unrestrained marketplace competition,[73]

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robot-ethics.html (last visited Nov. 26, 2009).

[69] *Id.*

[70] *Id.*

[71] An example is the International POPs Elimination Network (IPEN), "a unique global network of people and public interest organizations" that "share a common commitment to achieve a toxic-free future." *Welcome to the International POPs Elimination Network*, International POPs Elimination Network, *available at* http://www.ipen.org/ (last visited Oct. 4, 2010). IPEN is composed of over 700 public interest health and environmental organizations from more than 80 countries which describes itself as a "global network of more than 700 public non-governmental organizations working together in over 80 countries. Added to these groups is the literature which has come out of think tanks and academic institutions which speaks to the intersection of ethics and technological innovation.

[72] International Committee for Robot Arms Control, *available at* http://www.icrac.co.uk/ (last visited Oct. 4, 2010).

[73] The President's Council on Bioethics recognized this fact in its Report on the state of biotechnology in 2003: "Whether one likes it or not, progress in biology and biotechnology is now intimately bound up with industry and commerce….Whatever one finally thinks about the relative virtues and vices of contemporary capitalism, it is a fact that progress in science and technology owes much to free enterprise. The possibility of gain adds the fuel of interest to the fire of genius, and even as the profits accrue only to some, the benefits are, at least in principle, available to all. And the competition to succeed provides enormous incentives to innovations, growth, and progress. We have every reason to expect exponential increases in biotechnologies,

while recognizing, on the other hand, the need for the government to organize federal funding, encourage innovation, and regulate the more egregious results of commercialization.[74] Within the U.S., for example, there appears to be no urgency regarding the coordination of governance of emerging technologies such as robotics within the federal government generally; nor is there any evidence of a prevailing belief that the present governance architecture requires any type of thorough overhaul to respond to the challenges of the 21st century. Indeed the President's Council of Advisors on Science and Technology, in its report of April 2008 on nanotechnology, concluded:

> [T]here are *no ethical concerns that are unique to nanotechnology today*. That is not to say that nanotechnology does not warrant careful *ethical* evaluation. As with all new science and technology development, all stakeholders have a shared responsibility to carefully evaluate the ethical, legal, and societal implications raised by novel science and technology developments. However, the[re is] … no apparent need at this time to reinvent fundamental ethical principles or fields, or to develop novel approaches to assessing societal impacts with respect to nanotechnology.[75]

Turning to military uses of robotics, specifically, the development and use of robots for military purposes continues to be constrained, as mentioned above, by various restrictions regarding the projection of force found in international law that are translated into national laws and regulations. There are, as cited above, multiple conventions which purport to deal with specific technologies and practices. Even though the United States is not a party to all of these conventions, nor necessarily bound by all of them, it is nonetheless the case that the U. S. has taken considerable interest in the articulation of standards which purport to regulate conduct generally on the battlefield, including how weapons are used.

There are five principles which run through the language of the various humanitarian law treaties[76] (the rules) which the United States acknowledges and

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and, therefore, in their potential uses in all aspect of human life." The President's Council on Bioethics, *Beyond Therapy: Biotechnology and the Pursuit of Happiness* (2003), at 303, *available at* http://bioethics.georgetown.edu/pcbe/reports/beyondtherapy/beyond_therapy_final_webcorrected.pdf.

[74] *See, e.g.,* Harris-Kefauver Act, Pub. L. No. 87-781, 76 Stat. 780 (1962) (codified as amended at 21 U.S.C. § 301 *et seq.* (1998)) (commonly referred to as the 1962 Drug Amendments); National Research Act of 1974, Pub. L. No. 93-348, 88 Stat. 342 (1974); 21st Century Nanotechnology Research and Development Act, Pub. L. No. 108-153, 117 Stat. 1923 (2003).

[75] President's Council of Advisors on Science and Technology, National Nanotechnology Initiative: Second Assessment and Recommendations of the NNAP (2008), *available at* http://www.nano.gov/PCAST_NNAP_NNI_Assessment_2008.pdf (last visited Jan. 15, 2009) (emphasis added).

[76] Humanitarian law is that international law comprised of a set of rules which seek to limit

generally honors regarding the conduct of warfare. These are: (i) a general prohibition on the employment of weapons of a nature to cause superfluous injury or unnecessary suffering, (ii) military necessity, (iii) proportionality, (iv) discrimination, and (iv) command responsibility. These principles, as discussed below, impose ethical and arguably legal restraints on at least some uses of lethal autonomous robots.

First, some weapons, it is argued, are patently inhumane, no matter how they are used or what the intent of the user is. This principle has been recognized since at least 1907,[77] although consensus over what weapons fall within this category tends to change over time. The concept here is that some weapons are *design-dependent*: that is, their effects are reasonably foreseeable even as they leave the laboratory. In 1996, the International Committee of the Red Cross at Montreux articulated a test to determine if a particular weapon would be the type which would foreseeably cause superfluous injury or unnecessary suffering.[78] The so-called "SIrUS" criteria would ban weapons when their use would result in:

- A specific disease, specific abnormal physiological state, a specific and permanent disability or specific disfigurement; or
- Field mortality of more than 25% or a hospital mortality of more than 5%; or
- Grade 3 wounds as measured by the Red Cross wound classification scale; or
- Effects for which there is no well-recognized and proven treatment.[79]

The operative term here is *specific*; the criteria speak to technology specifically designed to accomplish more than render an adversary *hors de combat*. This test for determining weapons exclusion is a medical test and does not take into consideration the issue of military necessity. For this reason, these SIrUS criteria have been roundly

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the effect of armed conflict. Primary conventions include the Geneva Conventions of 1949, supplemented by the Additional Protocols of 1977 relating to the protection of victims of armed conflicts; the 1954 Convention for the Protection of Cultural Property in the event of armed Conflict and additional protocols; the 1972 Biological Weapons Convention; the 1980 Conventional Weapons Conventions and its five protocols; the 1997 Ottawa Convention on anti-personnel mines; and the 2000 Optional Protocol to the Convention on the Rights of the Child on the involvement of children in armed conflict. International Committee of the Red Cross, What is International Humanitarian Law? (2004), *available at* http://www.icrc.org/Web/Eng/siteeng0.nsf/htmlall/section_ihl (last visited Nov. 25, 2009).

[77] *See* Hague Convention (IV) Respecting the Laws and Customs of War on Land and Its Annex: Regulation Concerning the Laws and Customs of War on Land, Oct. 18, 1907, 36 Stat. 2227, *available at* http://www.unhcr.org/refworld/docid/4374cae64.html (last visited Oct. 9, 2010).

[78] D. Holdstock, *International Committee of the Red Cross: the medical profession and the effects of weapons*, 12 Medicine, Conflict and Survival 254 (1996).

[79] International Committee of the Red Cross, The SIrUS Project: Towards a Determination of Which Weapons Cause "Superfluous Injury or Unnecessary Suffering" (1997), *available at* http://www.loc.gov/rr/frd/Military_Law/pdf/SIrUS-project.pdf. *See also* Andrew Kock, *Should War be Hell?*, Jane's Defense Weekly, May 10, 2000, at 23.

criticized and rejected by the United States specifically, and by the international community generally, notwithstanding support for the general principle against the use of inhumane weapons.[80]

The second principle, *military necessity,* requires a different analysis. This principle "…justifies measures of regulated force not forbidden by international law which are indispensable for securing the prompt submission of the enemy, with the least possible expenditures of economic and human resources."[81] *Military necessity* recognizes the benefit to friend and foe alike of a speedy end to hostilities. Protracted warfare, it assumes, creates more rather than less suffering for all sides. In order to determine the necessity for the use of a particular technology, then, one needs to know what the definition of victory is, and how to measure the submission of the enemy in order to determine whether the technology will be *necessary* in this regard.

The third principle, *proportionality,* is of considerable concern to the developer and user of new technologies. A use of a particular technology is not *proportional* if the loss of life and damage to property incidental to attacks is excessive in relation to the concrete and direct military advantage expected to be gained.[82] In order to make this determination, it can be argued, one must consider the military necessity of a particular use and evaluate the benefits of that use in furtherance of a specific objective against the collateral damage that may be caused.

Discrimination, the fourth principle, goes to the heart of moral judgment. Indiscriminate attacks (uses) are prohibited under the rules. Indiscriminate uses occur whenever such uses are not directed against a specific military objective, or otherwise employ a method or means of combat the effects of which cannot be directed at a specified military target (indiscriminate bombing of cities for example). Indiscriminate usage also encompasses any method or means of combat, the effects of which cannot be limited as required, or that are otherwise of a nature to strike military and civilian targets without distinction.

A final principle is *command responsibility,* that principle which exposes a multiple of superiors to various forms of liability for failure to act in the face of foreseeable illegal activities. This is a time-honored principle, grounded on the contract between soldiers and their superiors, which requires soldiers to act and superiors to determine when and how to act. It has a long history reflective of the need for control on

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[80] *See* Donna Marie Verchio, *Just Say No! The SIrUS Project: Well-intentioned, but Unnecessary and Superfluous*, 51 A.F. L. Rev. 183 (2001).

[81] *See* Roy Gutman & Daoud Kuttab, *Indiscriminant Attack,* in Crimes of War, the Book, What the Public Should Know (2007), *available at* http://www.crimesofwar.org/thebook/indiscriminate-attack.html (last visited Oct. 9, 2010). "Military objectives are limited to those objects which by their nature, location, purpose or use make an effective contribution to military action and whose total or partial destruction, capture or neutralization, in the circumstances ruling at the time, offers a definite military advantage."

[82] Headquarters, Department. of the Army, U.S. Army Field Manual 27-10, The Law of Land Warfare, change 1, para. 41 (1976), *available at* http://www.globalsecurity.org/military/library/policy/army/fm/27-10/CHANGE1.htm (last visited Oct. 9, 2010).

the battlefield.[83]

A 1997 Protocol to the Geneva Convention requires that each State Party "determine whether the employment of any new weapon, means or method of warfare that it studies, develops, acquires or adopts would, in some or all circumstance, be prohibited by international law."[84] The legal framework for this review is the international law applicable to the State, including international humanitarian law ("IHL"). In particular this consists of the treaty and customary prohibitions and restrictions on specific weapons, as well as the general IHL rules applicable to all weapons, means and methods of warfare. General rules include the principles described above, such as protecting civilians from the indiscriminate effects of weapons and combatants from unnecessary suffering. The assessment of a weapon in light of the relevant rules will require an examination of all relevant empirical information pertinent to the weapon, such as its technical description and actual performance, and its effects on health and the environment. This is the rationale for the involvement of experts of various disciplines in the review process.[85]

Once again, the United States is not a signatory to this Protocol and thus, technically not bound by its requirements. Nonetheless, to the extent that it sets out reasonable requirements and methodologies for use by states fielding new and emerging technologies, however, this treaty could well set the standard in international law for what may be considered appropriate conduct. A final constraint worth noting is the emerging trend in international law to hold those responsible for fielding weapons which allegedly contravene the principles enunciated above through the use of litigation based on the concept of *universal jurisdiction*.[86] While litigation to date has revolved primarily

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[83] *See generally* Brandy Womack, *The Development and Recent Applications of the Doctrine of Command Responsibility: With Particular Reference to the Mens Rea Requirement*, *in,* International Crime and Punishment: Selected Issues, Volume I 117 (Yee Sienho ed., 2003).

[84] Protocol Additional to the Geneva Conventions of 12 Aug. 1949, and relating to the Protection of Victims of International Armed Conflicts, art. 36, 8 June 1977, 1125 U.N.T.S. 3, *available at* http://www.icrc.org/ihl.nsf/full/470?opendocument.

[85] Kathleen Lewand, A Guide to the Legal Review of New Weapons, Means and Methods of Warfare, Measures to Implement Article 36 of Additional Protocol I of 1977, International Committee of the Red Cross (2006), *available at* http://www.icrc.org/eng/assets/files/other/icrc_002_0902.pdf (last visited Oct. 10, 2010).

[86] The concept of universal jurisdiction is a customary international law norm that permits states to regulate certain conduct to which they have no discernable nexus. Generally, it is recognized as a principle of international law that all states have the right to regulate certain conduct regardless of the location of the offense or the nationalities of the offender or the victims. Piracy, slave trade, war crimes and genocide are all generally accepted subjects of universal jurisdiction. Belgium, Germany and Spain have all entertained such prosecutions. The issue of *lawfare* is also of concern. *Lawfare* is a strategy of using or misusing law as a substitute for traditional military means to achieve military objectives. Each operation conducted by the U.S. military results in new and expanding efforts by groups and countries to use *lawfare* to respond to military force. American military authorities are still grappling with many of these issues. *See* Council on Foreign Relations, Transcript, *Lawfare, The Latest in Asymmetries* (2003), *available*

around allegations of practices such as genocide, torture, rendition, and illegal interrogation, there is no reason to believe that future prosecutions may be justified where decisions regarding illegal innovation, adaptation, and use of weapons systems are made.

These various principles and requirements of international humanitarian law and ethical rules of military conduct would clearly impose some limitations on the development and use of lethal autonomous robots. However, given the ambiguous meaning and uncertain legal binding status of these principles, they are unlikely to adequately constrain and shape the development and use of LARs on their own. Additional oversight mechanisms may therefore be warranted, which are further explored in the subsequent section.

V. LEGALLY BINDING INTERNATIONAL AGREEMENTS

A more formal and traditional approach for oversight of a new weapons category such as LARs would be some form of binding international arms control agreement.[87] Under existing international law, there is no specific prohibition on lethal autonomous robots. In September 2009, robotics expert Noel Sharkey, physicist Jurgen Altmann, bioethicist Robert Sparrow, and philosopher Peter Asaro founded the International Committee for Robot Arms Control ("ICRAC") to campaign for limiting lethal autonomous robots through an international agreement modeled on existing arms control agreements such as those restricting nuclear and biological weapons.[88] ICRAC called for military robots to be barred from space and that all robotic systems should be prohibited from carrying nuclear weapons.[89] The ICRAC is a small group at this time and as of yet

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at http://www.cfr.org/national-security-and-defense/lawfare-latest-asymmetries/p5772 (last visited Dec. 10, 2009).

[87] Sparrow, *supra* note 41, at 27-29.

[88] Nic Fleming, *Campaign Asks for International Treaty to Limit War Robots*, New Scientist, Sept. 30, 2009, *available at* http://www.newscientist.com/article/dn17887-campaign-asks-for-international-treaty-to-limit-war-robots.html (last visited Oct. 10, 2010). *See also* The Statement of the 2010 Expert Workshop, *supra* note 4 (statement from expert workshop organized by ICRAC calling for an arms control regime that would prohibit the further development, acquisition, deployment, and use of autonomous robot weapons).

[89] *Id.* It is worth noting that there have long been discussions in other contexts of banning from space at least some weapons. For example, the Obama Administration has expressed an intent to seek a ban on weapons that "interfere with military and commercial satellites." *See, e.g.*, Frank Morring, Jr., *White House Wants Space Weapons Ban*, Aviation Week, Jan. 27, 2009, *available at* http://www.aviationweek.com/aw/generic/story_channel.jsp?channel=space&id=news/Spacewea012709.xml&headline=White%20House%20Wants%20Space%20Weapons%20Ban (last visited Oct. 10, 2010). In contrast, the National Space Policy issued by the Bush White House in 2006 states in part that the "United States will oppose the development of new legal regimes or other restrictions that seek to prohibit or limit U.S. access to or use of space." *See, e.g.*, Marc Kaufman, *Bush Sets Defense As Space Priority*, Wash. Post, Oct. 18, 2006, *available at* http://www.washingtonpost.com/wp-dyn/content/article/2006/10/17/AR2006101701484.html

its campaign does not yet seem to have gained the momentum necessary to spark a new international legal regime. However, there is precedent for a non-governmental organization, the International Committee to Ban Landmines, successfully leading the charge towards banning a weapons system.[90]

While ICRAC's work has raised the issue of limiting lethal autonomous robots through an international arms control agreement, the wisdom of such a course of action is far from clear. Do explicit international legal restrictions on lethal autonomous robots make sense? Are they feasible – both from a political and a technological perspective? Does the ICRAC's specific proposal make sense? The goal of this section is to make some preliminary points about what the options may be for international legal restrictions on lethal autonomous robots, if a policy choice is made to attempt to restrict them.

International law contains a significant number and diversity of precedents for restricting specific weapons. Existing legally binding arms control agreements and other instruments include a wide variety of different types of restrictions on targeted weapons, including prohibitions and limitations (restrictions that fall short of prohibition) on (i) acquisition, (ii) research and development, (iii) testing, (iv) deployment, (v) transfer or proliferation, and (vi) use.

These various types of prohibitions and limitations form a kind of menu from which the drafters of an international legal instrument addressing lethal autonomous robots – or other emerging warfighting technologies – could choose in accordance with their goals and the parameters of political support for such restrictions. A similar menu could be created of the various types of monitoring, verification, dispute-resolution, and enforcement mechanisms that implement the prohibitions and limitations contained in existing international legal arms control instruments.

These prohibitions and limitations (as well as any accompanying monitoring/verification, dispute-resolution, and enforcement provisions) can be contained in any of a number of different types of international legal instruments. They are typically contained in legally binding, multilateral agreements, including in multilateral agreements primarily focused on arms control and also in the Rome Statute of the International Criminal Court. However, there are also examples of prohibitions and limitations contained in legally binding, bilateral agreements, as well as examples of prohibitions and limitations contained in legally binding resolutions of the United Nations Security Council or in customary international law (which consists of rules of law derived from the consistent conduct of states acting out of the belief that the law required them to act that way). As with the content of the restrictions and their implementing provisions, the choice of type of instrument depends on the drafters' goals and the parameters of political support for the desired restrictions and implementing provisions.

New international legal arms control instruments are typically freestanding. However, there is also at least one existing multilateral legal framework agreement with respect to which it is worth exploring whether that agreement could usefully be amended to itself provide a vehicle for some or all desired restrictions on lethal autonomous robots.

(last visited Oct. 10, 2010).

[90] *See, e.g.*, Raymond Bonner, *How a Group of Outsiders Moved Nations to Ban Land Mines*, N.Y. Times. Sept. 20, 1997, at A5.

This is the 1980 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 (the CCW),[91] which has been ratified by over 100 state parties.[92]

The operative provisions of the CCW are contained within its protocols. The five protocols currently in force contain rules for the protection of military personnel and, particularly civilians and civilian objects from injury or attack under various conditions by means of: fragments that cannot readily be detected in the human body by x-rays (Protocol I), landmines and booby traps (amended Protocol II), incendiary weapons (Protocol III), blinding lasers (Protocol IV), and explosive remnants of war (Protocol V).[93] It is worth noting that the case that lethal autonomous robots should be restricted by the CCW could be made most effectively if it were argued that such robots are contrary to the "principle," cited in the CCW preamble, "that prohibits the employment in armed conflicts of weapons, projectiles and material and methods of warfare of a nature to cause superfluous injury or unnecessary suffering."[94]

A. Menu of Types of Restrictions Contained in Current International Legal Arms Control Instruments

Some international legal arms control instruments prohibit a full range of activities involving the targeted weapons. For example, State-parties to the Convention on the Prohibition of the Use, Stockpiling, Production and Transfer of Anti-Personnel Mines and on Their Destruction, typically referred to as the "Mine Ban Treaty," commit to not developing, producing, acquiring, retaining, stockpiling, or transferring anti-personnel landmines.[95] The following menu contains additional examples of existing international legal instruments which adopt the specified types of restrictions on a narrower basis:

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[91] 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 (CCW), Oct. 10, 1980, 1342 U.N.T.S. 137, *reprinted in* 19 I.L.M. 1523 (1980), *available at* http://www.unog.ch/80256EDD006B8954/(httpAssets)/40BDE99D98467348C12571DE0060141E/$file/CCW+text.pdf.

[92] *See, e.g.*, *Convention on Certain Conventional Weapons (CCW) At a Glance*, *available at* http://www.armscontrol.org/factsheets/CCW.

[93] *Id.*

[94] This argument would of course be contrary to the contentions of some robotics experts that lethal autonomous robots are particularly *unlikely* "to cause superfluous injury or unnecessary suffering."

[95] Convention on the Prohibition of the Use, Stockpiling, Production and Transfer of Anti-Personnel Mines and on Their Destruction, Sept. 18, 1997, 36 I.L.M. 1507 (1997).

1. Prohibitions and Limitations on Acquisition

Several international legal arms control instruments completely prohibit the acquisition of targeted weapons. For example, the Biological Weapons Convention ("BWC") prohibits all state-parties from acquiring, producing, developing, stockpiling, or retaining – and requires all state-parties to within nine months destroy or divert to peaceful purposes – 1) biological agents and toxins "of types and in quantities that have no justification for prophylactic, protective or other peaceful purposes"; and 2) weapons, equipment and delivery vehicles "designed to use such agents or toxins for hostile weapons or in armed conflict."[96] The Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on their Destruction ("CWC") prohibits all state parties from producing or acquiring, as well as developing, stockpiling or retaining, chemical weapons.[97]

In contrast, the Treaty on the Non-Proliferation of Nuclear Weapons ("NPT") creates two classes of states with regard to nuclear weapons.[98] Nuclear-weapon state-parties are those that had manufactured and exploded a nuclear weapon or other nuclear explosive device prior to January 1, 1967 (China, France, Russia, the United Kingdom, and the United States)[99] The NPT does not require nuclear-weapon state-parties to give up their nuclear weapons, but does require those parties to "pursue negotiations in good faith on effective measures relating to cessation of the nuclear arms race at an early date and to nuclear disarmament."[100] Non-nuclear weapon state parties to the NPT are prohibited from receiving, manufacturing, or otherwise acquiring nuclear weapons.[101]

The Inter-American Convention on Transparency in Conventional Weapons Acquisitions[102] provides a very different model, with a focus on transparency rather than

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[96] Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction (BWC), Apr. 10, 1972, 26 UST 583, 1015 U.N.T.S. 163, *available at* http://www.unog.ch/80256EDD006B8954/(httpAssets)/C4048678A93B6934C1257188004848D0/$file/BWC-text-English.pdf (last visited Oct. 10, 2010).

[97] Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on Their Destruction (CWC), Jan. 13, 1993, 1974 U.N.T.S. 45, *available at* http://www.opcw.org/chemical-weapons-convention/articles/ (last visited Oct. 10, 2010).

[98] Treaty on the Non-Proliferation of Nuclear Weapons (NPT), opened for signature July 1, 1968, 21 U.S.T. 483, 729 U.N.T.S. 161 (entered into force Mar. 5, 1970), *available at* http://www.iaea.org/Publications/Documents/Infcircs/Others/infcirc140.pdf (last visited Oct. 10, 2010).

[99] *Id.* at Art. IX.

[100] *Id.* at Art. VI.

[101] *Id.* at Art. II.

[102] Organization of American States, Inter-American Convention on Transparency in Conventional Weapons Acquisitions, June 7, 1999, *available at*

prohibition of acquisitions. The Convention does not prohibit any acquisitions but does require its state-parties to annually report on their imports of certain specified heavy weapons, as well as submit notifications within 90 days of their incorporation of certain specified heavy weapons into their armed forces inventory, whether those weapons were imported or produced domestically.[103]

2. Prohibitions and Limitations on Research and Development

Few, if any, international legal arms control instruments prohibit all research that could be useful for targeted weapons. Limitations on development differ from instrument to instrument. The CWC flatly prohibits the development of any chemical-weapon munition and device.[104] In contrast, the BWC contains a more nuanced prohibition, banning the development, production, acquisition, and retention of 1) microbial or other biological agents or toxins "of types and in quantities that have no justification for prophylactic, protective or other peaceful purposes" and 2) weapons, equipment or means of delivery "designed to use such agents or toxins for hostile purposes or in armed conflict."[105] It is important to note that restrictions based on quantities or intended use rather than the underlying nature of the technology can be exceptionally difficult to verify, at least without highly intrusive inspections.

3. Prohibitions and Limitations on Testing

Prohibitions and limitations on testing of targeted weapons are most prominent in the nuclear-weapons context. For example, the Comprehensive Test Ban Treaty ("CTBT"), which has not yet entered into force, prohibits "any nuclear weapon test explosion or any other nuclear explosion."[106] The CTBT's entry into force awaits ratification by nine key countries, including the United States.[107] In contrast, the 1963 Treaty Banning Nuclear Weapon Tests in the Atmosphere, in Outer Space and Under Water (also known as the "Limited Test Ban Treaty") – which unlike the CTBT is in force – specifically prohibits nuclear-weapons tests "or any other nuclear explosion" only

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http://www.oas.org/juridico/english/treaties/a-64.html (last visited Oct. 10, 2010).

[103] *Id.* at Art. III-IV.

[104] CWC, *supra* note 58, at Arts. I-II.

[105] BWC, *supra* note 57, at Art. I.

[106] Comprehensive Nuclear Test Ban Treaty, opened for signature Sept. 24, 1996, 35 I.L.M. 1439 (1996), *available at* http://www.ctbto.org/the-treaty/treaty-text/ (last visited Oct. 10, 2010).

[107] Comprehensive Nuclear Test Ban Treaty Organization Preparatory Commission, *CTBTO Fact Sheet* (2010), *available at* http://www.ctbto.org/fileadmin/user_upload/public_information/CTBT_FactSheet_02_2010.pdf (last visited Oct. 10, 2010).

in the atmosphere, in outer space, and under water.[108] The Limited Test Ban Treaty also prohibits nuclear explosions in all other environments, including underground, if they cause "radioactive debris to be present outside the territorial limits of the State under whose jurisdiction or control" the explosions were conducted.[109]

4. Prohibitions and Limitations on Deployment

Some international legal arms control instruments focus on limiting deployment of the targeted weapons, such as with overall or regional, numerical caps. For example, the Strategic Offensive Reductions Treaty, entered into by the U.S. and Russia in 2002, requires the two countries to reduce their operationally deployed, strategic nuclear forces to between 1,700 and 2,200 warheads by December 31, 2012.[110] The Conventional Armed Forces in Europe Treaty, ratified by the United States in 1992, contains bloc and regional limits on deployment of certain weapons.[111]

5. Prohibitions and Limitations on Transfer/Proliferation

Many international legal arms control instruments include prohibitions or limitations on transfer or other proliferation of the targeted weapons. For example, the NPT prohibits parties that possess nuclear weapons from transferring the weapons to any recipient as well as from assisting, encouraging, or inducing any non-nuclear-weapon state to manufacture or otherwise acquire such weapons in any way.[112]

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[108] Treaty Banning Nuclear Weapon Tests in the Atmosphere, in Outer Space and Under Water, Aug. 5, 1963, 480 U.N.T.S. 43, 14 U.S.T. 1313, *available at* http://disarmament.un.org/treatystatus.nsf/44e6eeabc9436b78852568770078d9c0/35ea6a019d9e058a852568770079dd94?OpenDocument (last visited Oct. 10, 2010).

[109] *Id.*

[110] Treaty on Strategic Offensive Reductions (SORT), May 24, 2002, U.S.-Russ., 41 I.L.M. 799 (2002), *available at* http://moscow.usembassy.gov/joint_05242002.html (last visited Oct. 10, 2010). *See also* Arms Control Association, *The Strategic Offensive Reductions Treaty (SORT) At a Glance*, *available at* http://www.armscontrol.org/factsheets/sort-glance (last visited Oct. 10, 2010).

[111] Treaty on Conventional Armed Forces in Europe (CFE), Nov. 19, 1990, 30 I.L.M. 1, *available at* http://www.dod.gov/acq/acic/treaties/cfe/index.htm (last visited Oct. 10, 2010). The Adapted Conventional Armed Forces in Europe Treaty, which has not been ratified by the United States, would replace the original treaty's bloc and regional arms limits with national weapon ceilings. *See* Arms Control Association, *The Adapted Conventional Armed Forces in Europe Treaty at a Glance, available at* http://www.armscontrol.org/factsheets/adaptcfe (last visited Oct. 10, 2010).

[112] NPT, *supra* note 98, at Art. I.

The CWC bans the direct or indirect transfer of chemical weapons.[113] The CWC also bans assisting, encouraging, or inducing anyone to engage in CWC-prohibited activity.[114] Similarly, the BWC bans the transfer to any recipient, directly or indirectly, and assisting any state, group of states, or international organizations to manufacture or otherwise acquire 1) biological agents and toxins "of types and in quantities that have no justification for prophylactic, protective or other peaceful purposes" and 2) weapons, equipment and delivery vehicles "designed to use such agents or toxins for hostile weapons or in armed conflict."[115] In contrast, the Inter-American Convention on Transparency in Conventional Weapons Acquisitions does not prohibit exports but does require its state-parties to annually report on their exports of certain specified heavy weapons.[116]

6. Prohibitions and Limitations on Use

Several international legal arms control instruments include prohibitions or limitations on use of the targeted weapons. The International Court of Justice, in its 1996 advisory opinion on the Legality of the Threat or Use of Nuclear Weapons, ruled that "the threat or use of nuclear weapons would generally be contrary to the rules of international law applicable in armed conflict, and in particular the principles and rules of humanitarian law; However, in view of the current state of international law, and of the elements of fact at its disposal, the Court cannot conclude definitively whether the threat or use of nuclear weapons would be lawful or unlawful in an extreme circumstance of self-defense, in which the very survival of a State would be at stake."[117] The Rome Statute of the International Criminal Court prohibits 1) employing poison or poisoned weapons, 2) employing poisonous gases, and 3) employing bullets which flatten or expand easily in the human body.[118] This list is potentially expandable. While the CWC bans chemical weapons use or military preparation for use,[119] the BWC does not ban the use of biological and toxin weapons but reaffirms the 1925 Geneva Protocol, which

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[113] CWC, *supra* note 58, at Art. I.

[114] *Id.*

[115] BWC, *supra* note 57, at Art. III.

[116] Inter-American Convention on Transparency in Conventional Weapons Acquisitions, *supra* note 102.

[117] International Court of Justice, *Legality of the Threat or Use of Nuclear Weapons*, Advisory Opinion, 1996 I.C.J. (July 8).

[118] *Rome Statute of the International Criminal Court*, July 17, 1998, 2187 U.N.T.S. 3 (1998).

[119] CWC, *supra* note 58.

prohibits such use.[120]

Protocol IV of the CCW prohibits the use of lasers specifically designed to cause permanent blindness.[121] It further obliges state-parties to make every effort to avoid causing permanent blindness through the use of other lasers.[122] While prohibiting the use of blinding lasers, the convention does not rule out their development or stockpiling.[123] However, it does outlaw any trade in such arms.[124]

B. Cautionary Note Regarding the Utility of International Legal Arms Control Instruments

It is worth noting that even the broadest and most aggressively implemented international legal arms control instruments suffer from certain inherent weaknesses. For example, existing international legal arms control instruments only apply to states. Their impact on non-state actors is at best indirect (for example, the CWC and BWC require state parties to prohibit activities on their territory that are prohibited directly for them). Yet non-state actors, particularly transnational terrorist groups, may present a significant threat of utilizing lethal autonomous robots. In addition, these international legal arms control instruments typically require state consent – states can choose not to ratify these agreements and can withdraw from them if they do join.[125]

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[120] BWC, *supra* note 57.

[121] Protocol IV on Blinding Laser Weapons, annexed to 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, Oct. 13, 1995, 35 I.L.M. 1218 (1996).

[122] *Id.* at Art. 2.

[123] *Id.* at Art. 1.

[124] For details of how the ban came about, *see* Louise Doswald-Beck, *New Protocol on Blinding Laser Weapons,* 312 Int'l Rev. Red Cross (1996), *available at* http://www.icrc.ch/web/eng/siteeng0.nsf/html/57JN4Y, and Christina Grisewood, *Limits of Lasers*, Mag. Int'l Red Cross and Red Crescent Movement, *available at* http://www.redcross.int/EN/mag/magazine1996_2/18-19.html.

[125] Arms control prohibitions or restrictions imposed by legally binding United Nations Security Council ("UNSC") resolutions, such as UNSCR 1540, differ from this model. A resolution approved by the UNSC under its Chapter VII authorities is legally binding on all UN member states, whether or not they supported the resolution. In addition, such a resolution typically cannot be rescinded or amended without the acquiescence of all five permanent members of the UNSC (China, France, Russia, UK, and U.S). Customary international laws are another form of international law that can in some circumstances bind states without their approval and from which states are in some circumstances not permitted to withdraw.

VI. SOFT LAW/GOVERNANCE APPROACHES

There have been a number of proposed strategies for managing the risks and regulating the uses of emerging military technologies.[126] Those strategies vary in formality and scope. Proposed measures range from formal, binding agreements such as treaties to informal initiatives such as codes of conduct.[127] Oversight of lethal autonomous robots is likely to lean towards the latter end of this spectrum at least initially. Some form of coordinated international oversight is warranted, but at least in the short term, formal "hard law" treaties may not be practicable.

In a growing number of areas of international oversight, ranging from environmental to commercial to social to military issues, traditional "hard law" treaties and agreements are being supplemented or in some cases displaced by new "soft law" approaches.[128] "Soft law" approaches seek to create and implement substantive principles or norms without creating enforceable legal requirements. The traditional model of binding international regulation that relies on formal treaties negotiated by government officials has a number of limitations, including the excessive resources and time needed to negotiate a formal international agreement, problems in enforcement of and compliance with such agreements, and the lack of flexibility and responsiveness in adapting such instruments to changing circumstances.[129]

Many new models of international oversight or harmonization have been developed to circumvent such problems. These new models tend to be more flexible and reflexive, capable of being launched relatively quickly and adapted easily to changing technological, political and security landscapes. These new soft law approaches have their own limitations, including perhaps most importantly that they are not as binding and often not as specific as traditional legal agreements. Yet, their growing popularity is due to advantages such as the relative ease by which they can be adopted and updated, and the broader roles they create for stakeholders to participate in their substantive formulation.[130]

Some of the key soft law/governance approaches that have been applied in other areas of emerging technologies that could conceivably be adapted to apply to the military

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[126] Comm. on Advances in Tech. and the Prevention of Their Application to Next Generation Biowarfare Threats Staff, Nat'l Research Council, An International Perspective on Advancing Technologies and Strategies for Managing Dual-Use Risks: Report of a Workshop 73-74 (Nat'l Academies Press 2005).

[127] *Id.*

[128] Kenneth W. Abbott & Duncan Snidal, *Hard and Soft Law in International Governance*, 54 Int'l Org. 421, 434-50 (2000) (providing numerous examples of "soft law" approaches in international law); Richard L. Williamson, Jr., *Hard Law, Soft Law, and Non-Law in Multilateral Arms Control: Some Compliance Hypotheses*, 4 Chi. J. of Int'l L. 59, 63 (2003) (detailing the growing use of "soft law" in international arms control).

[129] Abbott & Snidal, *supra* note 128, at 423.

[130] Williamson, *supra note* 128, at 63.

use of robotics are briefly described below.

A. *Codes of Conduct*

Codes of conduct are non-binding and often somewhat general guidelines defining responsible, ethical behavior and which are intended to promote a culture of responsibility. They can be developed and implemented by a variety of different entities, including governmental agencies, industry groups, individual companies, professional or scientific societies, non-governmental organizations, or collaborative partnerships involving two or more of these entities.

One of the first, and possibly most successful, codes of conduct was developed at the outset of the field of genetic engineering. The Asilomar guidelines on recombinant DNA research were adopted in the 1970s in response to safety concerns about some early genetic engineering experiments.[131] These guidelines were initially developed by scientists based on discussions at a 1975 conference held at the Asilomar Conference Center in Pacific Grove, California, and were subsequently adopted into more binding guidelines (at least for funding recipients) by the National Institutes of Health in 1976. The later guidelines have been widely complied with by scientists around the world.[132]

More recently, codes of conduct have emerged at the forefront of discussions to restrict the use of genetic engineering to create new biological weapons.[133] Although there are concerns that unenforceable codes of conduct will not provide strong enough assurances against the creation of new genetically engineered biological weapons, they may play an important bridging role in providing some initial protection and governance until more formal legal instruments can be negotiated and implemented.[134] In the same way, codes of conduct may play a similar transitional role in establishing agreed-upon principles for the military use of robots.

Codes of conduct are being created for other emerging technologies with potential military applications. The areas of synthetic biology and nanotechnology are two examples. In synthetic biology three different groups have recently proposed competing codes of conduct to manage security implications.[135] The groups are the U.S. Government, the International Association Synthetic Biology (IASB), and the

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[131] Paul Berg, *Asilomar 1975: DNA Modification Secured*, 455 Nature 290, 290 (2008).

[132] *Id.* at 290-91.

[133] Jeanne Guillemin, *Can Scientific Codes of Conduct Deter Bioweapons?* 07-06 MIT Center for International Studies Audit of the Conventional Wisdom (2007) at 1-2, *available at* http://web.mit.edu/cis/pdf/Audit_04_07_Guillemin.pdf.

[134] *Id.* at 3.

[135] *See* Markus Fischer & Stephen M. Maurer, *Harminizing Biosecurity Oversight for Gene Synthesis,* 28 Nature Biotechnology 20 (2010).

International Gene Synthesis Consortium (IGSC).[136] This proliferation of competing codes flags a key question about who has the authority and influence to promulgate effective codes of conduct that relevant parties will comply with.

A number of codes of conduct have also been created in the field of nanotechnology. The first code was developed by the Foresight Institute in the form of "guidelines," with a primary objective of discouraging the creation and deployment of autonomous replicating nanosystems.[137] The Foresight Institute guidelines have since been updated six times,[138] demonstrating the flexibility and adaptivity that is possible with codes of conduct which can be relatively easily updated (at least compared with a treaty or other more formal instrument). The current Foresight guidelines are extremely thorough and address issues and implications of nanotechnology in professional, industry, military, health, policy and other contexts.[139] The guidelines are based on the premise that professional ethics and soft law measures can be at least as effective as hard law in promoting safe practices.[140] The drafters of the Foresight guidelines also recognize the value in promoting the least restrictive legal alternative while developing good practices in areas of emerging technology.[141]

The European Union recently adopted a code of conduct for nanotechnology researchers.[142] The code promotes a responsible and open approach to research conducted within a "safe, ethical and effective framework."[143] Regular monitoring and revision of the code will occur in order to keep the code current with advances in nanoscience and nanotechnology.[144]

Another nanotechnology code of conduct originating in Europe, but with

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136 *Id.* at 20.

137 Neil Jacobstein, Foresight Institute, *Foresight Guidelines for Responsible Nanotechnology Development, Draft Version 6: April, 2006*, *available at* http://www.foresight.org/guidelines/ForesightGuidelinesV6.pdf, at 4.

138 *Id.* at 14-15.

139 *Id.* at 10-13.

140 *Id.* at 7-8.

141 *Id.* at 6.

142 *Commission Recommendation of 07/02/2008 on a Code of Conduct for Repsonsible Nanosciences and Nanotechnologies Research (July 2008), available at* http://ec.europa.eu/nanotechnology/pdf/nanocode-rec_pe0894c_en.pdf.

143 *Id.* at 5.

144 *Id.* at 6.

international applicability, is the Responsible NanoCode.[145] The Responsible NanoCode is an example of a code of conduct developed as a result of significant collaboration and designed to reach a wide target audience. The creators are United Kingdom's Royal Society, a nanotechnology industry trade group and a public interest organization.[146] The code is for companies that handle nanomaterials and the specific objective of the code is to "establish a consensus of good practice in the research, production, retail and disposal of products using nanotechnologies."[147] The code was developed to be universally applicable; it was devised "to be adopted by organisations in any part of the world, under any regulatory regime."[148]

Much of the discourse concerning codes of conduct tends to refer to codes of conduct as a single concept with a singular meaning or interpretation. But codes of conduct can exist on a continuum with respect to their objectives, specificity, audience, and expectations of compliance. The goal of all codes is to affect behavior, but different types of codes seek to shape behavior in different ways.[149] There are actually three primary types of codes: ethics, conduct, and practice.[150] Codes of ethics entail professionalism; codes of conduct espouse guidelines of appropriate behavior; codes of practice embody practices to be enforced.[151] Many codes, commonly referred to as codes of conduct, may in reality be a combination of the three types of codes.

The principal benefit of codes of conduct may not be the codes themselves, but rather the educational and cooperation-building effects of developing them.[152] So, notwithstanding the ultimate utility and efficacy (or lack thereof) of a code, its production may itself have expressive value. The discussion and collaboration required to develop a code raises awareness of relevant issues and prompts dialogue between relevant

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[145] ResponsibleNanoCode, Information on the Responsible NanoCode Initiative (May 2008), *available at* http://www.responsiblenanocode.org/documents/InformationonTheResponsibleNanoCode.pdf.

[146] *Id.* at 7.

[147] *Id.* at 3.

[148] *Id.* at 3.

[149] Royal Society, *The Roles of Codes of Conduct in Preventing the Misuse of Scientific Research*, Royal Society Policy Document 03/05 (June 2005) , *available at* http://royalsociety.org/The-roles-of-codes-of-conduct-in-preventing-the-misuse-of-scientific-research-/, at 2.

[150] Brian Rappert, *Towards a Life Sciences Code: Countering the Threats from Biological Weapons, in* Strengthening the Biological Weapons Convention 2004, at 3 (Briefing Paper 13, 2d Series., Dep't of Peace Studies, Univ. of Bradford, 2004), *available at* www.brad.ac.uk/acad/sbtwc/briefing/BP_13_2ndseries.pdf (last visited July 28, 2010).

[151] The Royal Society, *supra* note 149, at 2.

[152] Brian Rappert, Pacing Science and Technology with Codes of Conduct: Rethinking What Works (2010) (unpublished manuscript) (on file with author).

parties.[153] For example, individuals, institutions and countries must be aware of their ethical obligations.[154] Once a code is created it can help achieve that end by being a valuable educational tool.[155] It is critical that countries are aware of other countries' intentions and limits when it comes to the use of autonomous robots, and so it is reasonable to expect that the exercise of attempting to develop a code of conduct addressing these issues could have both utility and educational benefits.

Even though their tangible outcomes may be hard to identify, measure and quantify, codes of conduct possess unique features which make them attractive informal measures. The multiple codes of conduct that exist in the synthetic biology and nanotechnology industries highlight some of the salient benefits and drawbacks of codes of conduct. In terms of benefits, they can be created rather quickly compared to the time it would take to develop formal legal regulations. Codes can be drafted by interested parties who are knowledgeable in the area, and can be customized to address unique properties of a technology. On the other hand, one of the drawbacks of codes is their difficulty in application. Because anyone can craft a code of conduct, when multiple codes are introduced into an area, it is unclear whose code takes precedent. There is no hierarchical relationship amongst codes of conduct that would provide a clear sense of priority. The strengths of codes of conduct and other soft law mechanisms (being voluntary, cooperative, flexible measures) comes at a price: they have no rank order; they are all on the same playing field.

Despite sounding like a straightforward concept, it is not a simple process to create a code of conduct. Drafting a comprehensive, appropriate and effective code requires thorough consideration of myriad issues, attention to detail, as well as a proper balancing of the policy interests of interested parties.[156] While a code of conduct will not likely be sufficient to ensure the appropriate and ethical use of lethal autonomous military robots, the process of creating and disseminating such a code is undeniably a step forward and can be an important piece or at least starting point of an eventual treaty or agreement in this area.[157]

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[153] Royal Society, *supra* note 149, at 1.

[154] Margaret A. Somerville & Ronald M. Atlas, *Ethics: A Weapon to Counter Bioterrorism,* Science, Mar. 25 2005, at 1881.

[155] *Id.*

[156] Rappert, *supra* note 152, at 3.

[157] As discussed above, the most notable attempt to institute a code of conduct for military robotics to date is a "Code of Ethics" for robots being proposed by the Republic of South Korea, although the terms of the Code have yet to be fleshed out, and the code will apparently address issues relating to robots beyond just the military context. *See supra* note 68 and accompanying text.

B. Transgovernmental Dialogue

"Transgovernmental dialogue" refers to a growing number of informal and flexible arrangements under which governmental officials from different countries meet on a regular basis to discuss and coordinate polices. These opportunities provide a forum to share information and 'best practices,' to seek to harmonize policies and oversight mechanisms, to coordinate enforcement practices, and to help anticipate, prevent and resolve inter-national disputes.[158] Transgovernmental dialogue can greatly enhance cooperation and influence policy outcomes. It achieves that end through collaborative mechanisms and countries' shared desire to address a common problem or goal. These types of dialogues are beneficial to the nations involved and are becoming increasingly common in areas requiring international coordination, with national security issues being a prime example.[159] They offer "a structure that is less threatening to democratic governance than private transnational action and less costly than inter-state negotiations, yet they can lay a firm foundation for harmonized national regulation and even, if appropriate, for international regulation."[160]

An example of a transgovernmental dialogue in the national security context is the Australia Group, an informal forum of officials from forty-one nations with a common interest in preventing proliferation of materials that could be used for chemical or biological weapons.[161] Arising out of the experiences of the Iraq/Iran war of the late 1980s, the Australia Group was chiefly concerned with the use of chemical and biological weapons deployed in that conflict, but the Group has subsequently developed a list of dual use[162] items that that each country agrees to control through national export regulations. Since member countries do not have any legally binding obligations, achieving the goals set forth by the Australia Group depends completely on the voluntary good-faith commitment of the individual countries to the Group's goals.[163] The Group meets annually to discuss ways to prevent proliferation of chemical and biological agents through national export licensing policies and other measures.

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[158] Kenneth W. Abbott, Douglas J. Sylvester & Gary E. Marchant, *Transnational Regulation: Reality or Romanticism?*, in International Handbook on Regulating Nanotechnologies (Graeme Hodge, Diana Bowman and Andrew Maynard eds., 2010).

[159] *See* Patryk Pawlak, *From Hierarchy to Networks: Transatlantic Governance of Homeland Security*, 1 Journal of Global Change and Governance 1, 3 (2007) (discussing the shift from hierarchical to transgovernmental governance networks over the past decade, the accompanying structural and cultural shifts and their impacts on national security).

[160] Abbott et al., *supra* note 158.

[161] The Australia Group, http://www.australiagroup.net/en/index.html (last visited Feb. 26, 2010).

[162] "Dual use" simply refers to technology-based research and products that can be applied to both military and civilian use.

[163] *The Australia Group: An Introduction*, The Australia Group, http://www.australiagroup.net/en/introduction.html (last visited Feb. 26, 2010).

Another example of an existing transgovernmental institution is the *International Conference on Harmonisation of Technical Requirements for Registration of Pharmaceuticals for Human Use (ICH),* which brings together pharmaceutical regulators from the US, Europe, and Japan, along with pharmaceutical industry representatives from the same three jurisdictions, to coordinate pharmaceutical regulatory policy issues with a view to harmonization.[164] In addition to increasing harmonization, another goal of the ICH is to reduce the need for duplication of testing products, an accomplishment which is intended to reduce delays in the development and distribution of new medicines around the world.[165]

A third example is the Organization for Economic Co-operation and Development (OECD), an organization of 30 industrialized countries that has created two committees (the Working Party on Manufactured Nanomaterials (WPMN) and the Working Party on Nanotechnology (WPN)) to undertake a variety of informal harmonization activities.[166] The objective of the WPN is to promote international co-operation that fosters the research, development, and responsible commercialization of nanotechnology.[167] The WPN facilitates communication between governments which promotes discussion, awareness, and ideally a coordination of policy responses.[168] Meanwhile, the WPMN is an international effort to analyze the environmental health and safety risks posed by nanotechnology.[169] Another example from the nanotechnology realm is the International Dialogue on Responsible Research and Development of Nanotechnology, a forum that has brought together regulators from almost 50 nations every two years (2004, 2006, 2008) to discuss nanotechnology regulation.[170] The initial meeting of this forum was sponsored by an NGO (the Meridian Institute), but the national governments volunteered to sponsor subsequent meetings (Japan in 2006 and the EU in 2008).

These various examples of transnational dialogue are effective in starting a discussion among policymakers from different nations, and are relatively easy and quick

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[164] Int'l Conference on Harmonization, *Welcome to the Official Web Site for the ICH*, *available at* http://www.ich.org/cache/compo/276-254-1.html (last visited Oct. 10, 2010).

[165] *Id.*

[166] OECD, *Nanotechnologies at the OECD*, in Sixth Session of the Intergovernmental Forum on Chemical Safety, Dakar, Senegal 2 (2008), *available at* http://www.who.int/ifcs/documents/standingcommittee/nano_oecd.doc (last visited July 29, 2010).

[167] *Id.* at 7.

[168] Gary E. Marchant et al., *International Harmonization of Regulation of Nanomedicine* 3 Studies in Ethics, Law, and Technology 1, 7 (2009), *available at* http://www.bepress.com/selt/vol3/iss3/art6/ (last visited April 16, 2011).

[169] *Id.* at 7.

[170] Meridian Institute, *Report on the International Dialogue on Responsible Research and Development of Nanotechnology* (2004), *available at* http://cordis.europa.eu/nanotechnology/src/intldialogue.htm (last visited July 28, 2010).

to implement. The only major requirement is a sponsoring organization or nation to convene the initial meeting. While these dialogue initiatives do not usually create any binding international policies, they can be an important first step to more concrete policy measures in the future, and such a model may serve a useful function in starting dialogue amongst government policymakers on international policies for military robots.

C. Information Sharing and Confidence-Building Measures

Various types of information sharing and other confidence building measures have been used to enhance stability, trust and security for a variety of problems, including in the military and national security contexts. Information-sharing and confidence-building measures ("CBMs") can be either adopted unilaterally or coordinated or negotiated among several parties. The concept of CBMs arose in the sphere of international relations, and such measures are frequently used in international conflicts as the initial steps for reducing hostilities between enemies. In this international context, CBMs usually involve some mix of communication, constraint, transparency, or verification measures. Information sharing mechanisms are one type of CBM. An example of a legally-implemented information sharing mechanism is the Biosafety Clearing-House, which was applied under the Cartagena Protocol to the U.N. Convention on Biodiversity, creating a web-based portal that provides a forum for nations to share information on scientific risk of biotechnology products, as well as regulatory, legal and ethical determinations from each nation.[171]

One could envision a variety of potential CBDs for military LARs, consisting of either unilateral or multilateral initiatives. For example, individual or groups of nations could commit to a limited moratorium on the deployment of such systems. Nations could share information on technical issues with regard to LARs including issues relating to potential compliance and verification of any future international agreements. Nations could even take relatively minor but helpful steps by holding an international conference to discuss LAR issues.

D. Framework Convention

A final potential soft law mechanism, which is really more of a hybrid between soft law and the more formal international agreements discussed in the previous section, is a framework agreement or convention. A framework convention at its most basic level creates a process and an institutional basis for gradually developing a more substantive international agreement. It consists of an initial agreement to create the framework agreement, often with little or no substantive legal "teeth" originally, but that sets in place: an annual meeting of representatives of the participating nations, perhaps a small secretariat to manage the process, and provisions for negotiating and adopting more substantive protocols that member nations can then ratify on an individual basis. For example, the Vienna Convention for the Protection of the Ozone Layer began as a rather

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[171] Convention on Biological Diversity, *Biosafety Clearing-House*, *available at* http://bch.cbd.int/ (last visited Oct. 11, 2010).

weak agreement, but was gradually strengthened by various additions and protocols over time such as the Montreal Protocol and its amendments. Other prominent examples of such agreements include the Framework Convention on Climate Change and the Framework Convention on Tobacco.

While the lack of substantive content at the outset may seem a weakness of such agreements, it has the benefit of thereby being non-threatening to states that may otherwise be reluctant to sign onto any international agreement because of major scientific and technological uncertainties, differences in perspective, or distrust of other participating states. Once the nations agree to participate, the framework agreement can be a vehicle for greater convergence of positions and building of trust going forward, opening the door for more substantive commitments on an incremental basis. A framework agreement provides several potential benefits to states, including to:

- acknowledge that a problem may exist, legitimating it as an international concern;
- draw the attention of relevant experts, interest groups, and the public to the problem;
- commit themselves to take, or at least consider, more substantive action if the problem proves to be sufficiently serious; and
- demonstrate that they are taking the issue seriously.[172]

In addition to these benefits, the framework agreement can sometimes involve more concrete steps such as the establishment of technical or scientific committees that can provide an important understanding and cooperation on such issues, and potentially the inclusion of reporting and other information-sharing mechanisms that can improve transparency. All of these mechanisms and benefits would potentially be timely and useful for addressing LARs.

VII. CONCLUSION

Many years ago, David Collinridge recognized a fundamental tension in the governance of new technologies – prior to the development and deployment of the technology, not enough is known about its potential risks to warrant or guide any restrictions or limitations, whereas once the technology has been developed and deployed, it is often too late to undertake meaningful regulations because the commercial momentum behind the technology is now too strong and entrenched.[173] There is an opportunity to break this cycle with respect to lethal autonomous robotics. Enough concern and information exists now to consider appropriate governance models in a timely and proactive manner; yet, the time to take action is short before the current window of opportunity to design a relevant governance or oversight system for LARs closes.

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[172] Abbott et al., *supra* note 158.

[173] *See generally* David Collingridge, The Social Control of Technology (1980).

The need to take action on LARs is therefore urgent and timely. This article has not tried to prescribe a specific action or form of oversight, but rather has sought to identify the range of possible governance mechanisms that can be brought to bear on this problem. This can range from ethical principles implemented through modifications or refinements of national policies, to changes in the law of war and rules of engagement, to international treaties or agreements, or to a variety of other "soft law" governance mechanisms. Of course, any governance approach need not be restricted to any one of these modes of oversight, but could involve a combination of approaches. The critical point is that discussions on these options must proceed promptly, at both national and international levels, if we are to successfully manage the convergence of rapidly advancing robotics technology with military needs, incentives and temptations.