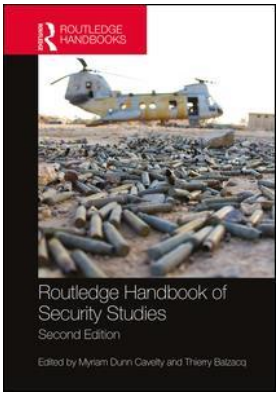

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Myriam Dunn Cavelty, Thierry Balzacq

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Myriam Dunn Cavelty, Sophie-Charlotte Fischer, Thierry Balzacq
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'KILLER ROBOTS' AND PREVENTIVE ARMS CONTROL

Myriam Dunn Cavelty, Sophie-Charlotte Fischer, and Thierry Balzacq

> When change is easy, the need for it cannot be foreseen; when the need for change is apparent, change has become expensive, difficult and time consuming.
>
> *(Collingridge 1980: 11)*

The Collingridge Dilemma (see above) indicates that policy-makers face a double-bind quandary in the regulation of emerging technologies: on the one hand, they are hesitant to endorse preventive measures in the absence of complete information about the characteristics and effects of the technology. On the other hand, once the technology is fully developed, controlling its further evolution comes at a high cost, mainly due to the level of investments made for its development and deployment, or the advantages the technology is bringing (cf. Williams and Edge 1996).

The dynamic described by Collingridge is also influencing the debate about the future regulation of 'Lethal Autonomous Weapons Systems' (LAWS), colloquially called 'killer robots'. In the not too far future, it could be technologically possible to build fully autonomous weapons that select and engage human targets in conflict without human intervention. However, since these weapons do not yet exist, designing them to minimize risks and optimize benefits is still possible – but so is banning them entirely. It is widely agreed upon among experts and policy-makers that the time to decide how to regulate their use is now, before the technology has become too 'hardened' – but there is no agreement on what kind of regulatory action should be taken, given different takes on the risks of these technologies, and different ethical and moral standpoints.

Three positions with regard to their regulation are discernible. Proponents of the first group lobby for a complete ban (or a prohibitory treaty) on killer robots. The second group of experts calls for an arms control regime of the 'regulatory' type, to restrict only specific features of autonomous weapons systems, or limit the context in which they are employed. The third camp advocates an adaptive 'norms' approach, defined by the 'gradual evolution of codes of conduct based on traditional legal and ethical principles governing weapons and warfare' (Anderson and Waxman 2013: 2), thus arguing that no special or additional international treaty is needed.

This chapter unpacks the assumptions about ethics, technology, and the future of warfare that inform these positions. It has three parts. In the first, we compare definitions of LAWS and give examples of technologies with differing degrees of autonomy. In the second, we look at

the literature in Security Studies (broadly understood) with bearing on LAWS. In the third, we discuss the three regulatory options and the scholarly opinions that inform them in more detail. We conclude with thoughts on what the main issues are, going forward, and what type of further research is needed from a Social Science/Security Studies perspective.

The technology

Some define LAWS as weapons that 'once activated, can select and engage targets without further intervention by a human operator' (DoD 2012a: 13). Others include the learning capabilities of machines ('artificial intelligence'), and define an autonomous weapon as 'one that is programmed to learn or adapt its functioning in response to changing circumstances in the environment in which it is deployed' (Lawand 2013). However, there is no agreement on a standard definition of LAWS, which makes discussions about them across different groups of experts quite difficult (Anthony and Holland 2014: 424). It is particularly noteworthy that the words 'automatic', 'automated', and 'autonomous' are used in inconsistent, even confusing ways (Scharre and Horowitz 2015: 4–5). The add-on 'unmanned' is also often used to signify different degrees of autonomy, which further adds to the confusion.

Even though there is no agreed-upon definition, it is fairly common to distinguish between different types of weapons based on how much human supervision or involvement in their operation is needed. The 'decline' of human decision-making (Adams 2011) is indeed the single most important cause for the ethical and legal debates around the use of autonomous weapons in warfare, especially if coupled with the prospect of artificial intelligence. Making degrees of human control the defining feature, Human Rights Watch (2012) proposes a useful distinction between three types of robotic weapons:

- Human-in-the-loop weapons: robots that can select targets and deliver force only with a human command;
- Human-on-the-loop weapons: robots that can select targets and deliver force under the oversight of a human operator who can override the robots' actions;
- Human-out-of-the-loop weapons: robots that are capable of selecting targets and delivering force without any human input or interaction. Only this last type is considered fully autonomous.

Because it is likely that the continuous adaptation of existing weapons, rather than the design of radically new systems, is the pathway to fully autonomous (human-out-of-the-loop) weapons, it is noted that it makes sense to think of them as situated on an evolving spectrum of autonomy, rather than as fixed classes of items (or technologies).

At the moment of writing, there are many human-in-the-loop, a few human-on-the-loop, and no human-out-of-the-loop systems in use. Unmanned (automated) systems – they are either in-the-loop or on-the-loop – are currently being developed and deployed by several nations including the United States, Israel, South Korea, Britain, France, Germany, Denmark, Sweden, China, and India (Sparrow 2009b: 170). In particular, unmanned aircraft piloted from afar ('drones'), some of which are used for targeted killings, are a significant and well-known component of the US war-fighting arsenal. In Table 42.1, we list a few weapon systems for each category.

It is important to note that, depending on how the weapon systems are programmed and used, several of the on-the-loop systems can also be considered in-the-loop systems, and vice versa. Even though today's robotic weapons still have a human being in the decision-making loop and

Table 42.1 Examples of different robotic weapons technologies in use (see DoD 2013; DoD 2012b; USAF 2014; Scharre and Horowitz 2015)

Type	*Current*	*Future/Planned*
Human-in-the-loop	Uninhabited Air Vehicles (UAVs), e.g. Global Hawk Combat Aerial Vehicles (UCAVs), e.g. Predator and Reaper Unmanned Ground Systems Unmanned Maritime Systems	
Human-on-the-loop	Automatic weapons defense systems. e.g. US Navy's MK 15 Phalanx Close-In Weapons System, the US ship-based Aegis and the land-based Israeli Iron Dome Sentry robots, e.g. SGR-1s, Guardium) 2nd generation unmanned aircraft (like Navy X-47B, Taranis) Active protection systems for ground vehicles to automatically engage incoming rockets or missiles, e.g. The French Shark or Russian Arena systems	Scalable Swarms of Autonomous Robots and Mobile Sensors (SWARMS) Low-Cost Autonomous Attack System (LOCAAS)
Human-out-of-the-loop		Nano Swarms (no concrete plans known)

require human intervention before the weapons take any lethal action, several observers point out that the move towards increasing levels of autonomy is inevitable (Anderson and Waxman 2013: 2; Liu 2012; Schmitt and Thurnher 2013: 237). Robotic weapons with various degrees of autonomy will most likely be a key feature across battlefield environments, especially since the majority of contemporary robotics research is funded by the military (cf. Harris 2012; Sparrow 2009a).

The literature in Security Studies

The use of robotics in warfare is a relatively recent development – and the first major books about the topic appeared only in 2009 (cf. Arkin 2009; Krishnan 2009; Singer 2009). In Security Studies, there are two types of literature that address aspects of LAWS. Both are relatively small; the majority of writings on the topic currently exist in legal studies or are published by American think tanks. The first body of literature is of a military and strategic nature. It mainly discusses causes for and consequences of making weapons systems increasingly autonomous, often embedding the discussion in the larger context of the ongoing military-technical revolution (see Krepinevich 2002; also Marchant et al. 2011), which is characterized by the 'rise of computer-driven information systems coupled with the proliferation of mobile autonomous and semi-autonomous systems' (Adams 2011: 2). This type of literature is in the old tradition of accounts that look at how specific technology changes the nature of war and warfare.

The second type of literature focuses specifically on drone warfare and targeted killings, an actual and observable practice of warfare using in-the-loop weapons, and is in the tradition of critical Security Studies. Drone killing is seen as visible expression of profound transformations of some of the enduring material and ideational features of war as we once knew it. It mirrors many of the points raised in military strategic writings, but is less future-oriented, seeing that drone warfare is a reality already.

Military Strategic Studies

Debates over the legal and ethical dimensions of new weapons, and also emergent ones, have been a feature of military thinking for a long time (cf. Tripodi and Wolfendale 2011), with specialized journals like *Military Ethics*[1] building up a scholarly body of knowledge around them (see, for example, Johnson and Axinn 2013; Roff 2014; Sharkey 2010). The emergence of new technology tends to be accompanied by two types of debates: the one that praises its (strategic) advantages and the one that mainly focuses on its downsides and risks.

By those focusing on the advantages, robots, whether manned or unmanned, ground or aerial, are regarded as effective tools that enable states to reduce personnel costs, to access denied areas controlled by enemies, and to wage wars with minimal footprint. Robots either do things humans cannot do or take what human beings used to do to an unprecedented level of sophistication in terms of speed and precision. Thus, robots revolutionize both the instruments and methods of war, even calling for 'entirely new concepts of operation' (Scharre 2014: 10; also see Brimley et al. 2013). Furthermore, autonomy would enable armies to use robots as force multipliers: one commander is sufficient to lead and coordinate a broad-scale robot attack.

Most importantly, the use of automated robots in future warfare will be driven by a desire to minimize the risk for one's own soldiers, but also a belief that such systems and their precision-strike capabilities will reduce the risk of 'collateral damage' among civilians (Strategic Defence Intelligence 2015). Not least, humans are often depicted as a problem in the operation of modern systems, since they are prone to make mistakes or underperform more generally (Adams 2011: 7); giving some tasks solely to machines is then seen as a way to reduce risks. Some experts even claim that machines might be much better at complying with the law of war (Geiss 2015: 16; also Arkin 2007: 58) because they do not feel fear or other emotions. However, differences in opinion often come down to beliefs as to whether autonomous systems can be programmed to comply with the rules of international humanitarian law.

The more sceptical observers have multiple objections to the use of machines for killing. The first is a moral argument. US Colonel Lee Fetterman for example warns that 'the function that robots cannot perform for us – that is, the function we should not allow them to perform for us – is the decide function . . . We would be morally bereft if we abrogate our responsibility to make life-and-death decisions required on the battlefield' (cited in Davis 2007). This is related to questions of responsibility (and liability): who would be to blame if a machine committed a war crime? (see Asaro 2012; Human Rights Watch 2012; Sharkey 2012).

A second is also related to moral and ethical issues, but is more specific. An often-made argument in relation to new and 'better' weapons is that they have disrupted the prevailing norms of warfare by radically and illegitimately reducing combat risk to the party using them. There is therefore a fundamental dilemma in the trade-offs between substantial gains in the ability to make war less destructive and harmful, primarily through the benefits of greater automated weapon precision, and significant dangers that military force will be used more destructively and with less ethical virtue on the other (Anderson and Waxman 2013: 2). This is followed by claims that by removing human soldiers from risk and reducing harm to civilians through greater precision, the disincentive to resort to armed force is diminished (Asaro 2012) – a point raised previously, i.e. with respect to remotely-piloted UAVs, and high-altitude bombing before that.

Another objection is related to the loss of control that this technology could bring. As war begins 'to leave the realm of human senses' (Adams 2011: 1), moving away from what we can see and hear and away from human reaction times, there is fear in some military quarters that it will 'remove warfare almost entirely from human hands' (Adams 2011: 2). Believing in 'meaningful human control' becomes questionable as soon as the time to make a counter-decision gets

reduced to nanoseconds – or if one considers unintended and unpredicted interactions between automated or autonomous systems, given the possibility for future artificial intelligence functions.

Critical Security Studies and drone warfare

The second body of literature is the contribution of critical approaches to security, which problematizes the ways in which the increasing use of drones brings together, and rearranges, strategies, practices, and technologies of war (Benjamin 2012; Grondin 2011). For critical scholars, the 'dronification of state violence' introduces three major turns in the way war is thought, waged, and experienced (Shaw and Akhter 2014): first, modern warfare was fought within tight geographical constraints; drone warfare erodes the importance of classical geography. Second, the modern way of war's objects and subjects were primarily sovereign states; in an attempt to develop a 'perfect war', drone warfare individualizes war, and hence makes 'life its target' (Anderson 2009; Shaw 2013: 540). Finally, drone warfare institutionalizes a permanent state of war, wherein pre-emption becomes the rule.

With advances in drone warfare, the material power of topography and the ability of states to project their power are disengaged. It is not the territory that is targeted; instead, drones' aims are spaces of circulation that are enacted by patterns of life. A drone does not only challenge distance, but it also takes killing from distance to an unprecedented level (Gregory 2011: 192). Distant areas, such as Pakistan, Somalia, Afghanistan or Yemen, are thus brought to the gaze of the pilot, who might be located thousands of miles away from the theatre of operations. In fact, by digitizing space, and bodies that transform it into matter of concern, drone deployment brings the faraway right into the intimacy of the pilot (Shaw 2013: 550). This intimacy is made possible through the creation of a 'scopic regime', that is, a regime of visibility that collapses 'here' and 'there' or makes 'there' available 'here' (Gregory 2011: 190), thanks to technological sensors that produce high-resolution images that surpass what conventional bomber pilots used to see.

The scopic regime brought about by drones leads to a new political geography. This new political geography is associated with two major transformations: first, it goes hand-in-hand with the compression of time, as drone warfare exerts a heavy pressure on the kill-chain. Killing occurs as the targeted body emerges on the screen. Second, the new political geography debases the classical distinction between 'inside' and 'outside', through which Hobbes' social contract operated. Without a clear centre, man-hunting now happens everywhere; it is no longer restricted to fields of interstate war, as evidenced by the Global War on Terror. It is thus the very idea of modern sovereignty that is called into question, as drones' primary targets are 'stateless' human bodies (Wilcox 2015: 129). In short, drone killing individualizes war. The 'predator empire', to use Shaw's words (2013), ignores a state's exclusive authority over a territory, and thrives in a seamless space wherein war has neither temporal nor geographical limits (Wilcox 2015: 128).

The targeting practices enabled by drones generate their own set of problems. On the one hand, the use of drones tends to privilege 'signature strikes' over 'personality strikes'. On the other hand, it disposes the kill-chain to rely on anticipatory and pre-emptive action. The two issues are interlinked. The difference between signature and personality strikes is that the latter concern persons whose identities are known and stored in a classified list of people to be killed, whereas the former deal with people's trajectories, that is, the traces that their lives enact. But this reliance on signatures is not immune to lethal mishaps; without a trial or a judicial hearing of suspects, the standard of evidence that would allow the kill-chain such a determination appears arbitrary. For Shaw (2013: 546), the focus on signatures (traces) explains the impressive increase in the number of people killed by drone strikes – from 9 (between 2004 and 2007) the numbers have soared to 300 (between 2008 and 2012). According to Braun (2007: 19), this kind of future-oriented

biopolitics 'takes as its target potential rather than actual risks'. That is, pre-emption is asserted as the main rationale that shapes drone strikes globally.

Even though this particular literature does not focus much on the future of robotic warfare, many of the points raised are in line with those of the opponents of killer robots. For them, in-the-loop weapons that are in actual use today belie the dream that future war can be 'clean' (with little to no collateral damage); they already violate human dignity; the imperative of distinction and proportionality is made moot. Any further automation would only aggravate these issues.

Regulating killer robots: issues of arms control

Even though forecasts on the dangers that autonomous weapon systems will pose in the future remain largely speculative at present, in 2014 a group of states launched multilateral expert meetings on the implications of, and the necessity to preventively regulate, LAWS in the frame of the Convention on Certain Conventional Weapons (CCW). Since then, state delegates have convened twice a year with legal, technical, and policy experts, as well as representatives of NGOs, to discuss outstanding issues on LAWS and to chart the further course of the debate.

While the majority of states supports consultations on LAWS in a multilateral forum, the debate has suffered from a lack of common definitions, and from diverging conceptions about a suitable regulatory approach. Although far-reaching agreement exists that humans should always remain part of lethal decision-making processes, a major point of discussion remains how 'meaningful human control' in autonomous systems can be defined. Apart from outstanding definitional issues, governments support differing regulatory approaches ranging on a wide spectrum from a full-scale ban to a status-quo approach that deems existent international law as sufficient to cover LAWS (Campaign to Stop Killer Robots 2015).

The existing literature on the governance of these technologies mirrors the heated policy debate on the regulation of LAWS – and to some degree even informs it. While most scholars agree that LAWS might have the potential to violate international humanitarian law and therefore might require preventive regulation or at least continuous observation, their conclusions and recommendations on an adequate approach vary widely. Three prevalent streams can be identified in the current discourse, two of which are pro-treaty. One group postulates the creation of a binding multilateral treaty to preventively regulate the development and use of LAWS. However, within this camp, one side, backed by several NGOs, calls for a full-scale ban on LAWS in the form of a prohibitory treaty, while the other, less radical, side suggests a regulatory treaty that restricts only certain technological features, or the context in which the weapons may be used. The third group rejects the utility of a preventive approach and contends that norms governing the manufacture and use of LAWS can only evolve incrementally, along with the technology. In the following, we provide deeper insights into the main premises and potential shortcomings of the three approaches.

A prohibitory treaty: banning LAWS

The regulatory approach that has gained most public attention so far is an outright ban of LAWS. A cornerstone in the development of this proposal was the report 'Losing Humanity: The Case against Killer Robots' published jointly by Human Rights Watch and the Harvard Law School International Human Rights Clinic in 2012. According to the report, 'killer robots' would increase the risks for civilians in war and thereby violate basic principles of international humanitarian law. Therefore the development, production, sale, deployment, or use of fully autonomous weapons should be prohibited (Human Rights Watch 2012). The activist group 'Campaign to Stop Killer Robots', a growing coalition of currently fifty-five NGOs, took up

the issue and urged governments to launch multilateral consultations on LAWS and to join the call for a ban. Over time, the proposal has gained increasing support from several prominent individuals and governments.

In 2015, a group of leading scientists in the fields of robotics and artificial intelligence announced their support for a prohibitory treaty of autonomous weapons without meaningful human control in an open letter released by the Future of Life Institute (Future of Life Institute 2015). Moreover, during the last sessions of the CCW on LAWS, Bolivia, Cuba, Ecuador, Egypt, Ghana, Pakistan, the State of Palestine, and the Holy See expressed their backing of a ban (Campaign to Stop Killer Robots 2015). However, other governments and especially those at the forefront of developing and already employing increasingly autonomous systems, like the US and China, remain reluctant to endorse such a far-reaching treaty (Foster and Haden-Pawlowski 2015).

A full-scale ban would outlaw LAWS as a weapons category and thereby declare them as illegal per se, independent of the targets they engage and the context in which they are used (Schmitt 2013). Proponents of a ban contend that fully autonomous weapon systems would not be able to adequately protect civilians in war. This claim is based on legal and ethical grounds. Legally, the argument goes, fully autonomous weapons systems could not adhere to fundamental principles of international humanitarian law, quoting in particular the principles of distinction and proportionality. A robot would never be capable of clearly distinguishing with its sensors between combatants and non-combatants, or of recognizing when a combatant surrendered (Sharkey 2012). From an ethical point of view, lethal decision-making should never be left to a machine alone and a significant degree of 'meaningful human control' needs to be maintained (Human Rights Watch 2012). Finally, only a ban would effectively stigmatize LAWS, thereby also forcing non-signatory states to comply with the newly created treaty obligations over time (Foster and Haden-Pawlowski 2015).

A prohibitory treaty could take different legal forms. Examples from the history of arms control have been repeatedly compared with a potential ban of LAWS. One option would be a sixth Additional Protocol to the CCW. Additional Protocols provide the opportunity to react to emerging conventional weapons of humanitarian concern that were not yet existent at the time when the Convention was created. The fourth Protocol on the prohibition of Blinding Laser weapons, the only successful pre-emptive ban of any weapon to date, could serve as a blueprint for a ban of LAWS. Another possibility would be an independent treaty modelled after the Ottawa Convention on Anti-Personal Landmines that was concluded in 1997 (Anderson and Waxman 2013). Considering that decisions in the frame of the CCW are taken by consensus and that several states currently reject a ban of LAWS, an independent treaty appears to be the more realistic option, although no consultation process independent of the CCW has been initiated yet.

A regulatory treaty: restricting levels of autonomy and the context of use

A less radical approach in comparison to a full-scale ban is a regulatory treaty that would restrict only specific features of autonomous weapons systems or limit the context in which they are employed. Although the proposal has received less public attention so far, several scholars advocate a regulatory treaty (Dickow and Mutschler 2015; Lewis 2015; Müller and Simpson 2014; Schmitt 2013). The Israeli delegation also proposed a regulatory approach at the CCW meeting in April 2015 (Campaign to Stop Killer Robots 2015).

Proponents of a regulatory treaty argue from a consequentialist point of view that autonomous weapons systems are not unlawful per se. Instead, the legality of the technology and its use should be carefully reviewed with regard to different settings and the potential consequences of its employment (Dickow and Mutschler 2015; Lewis 2015; Müller and Simpson 2014; Schmitt 2013).

Under certain conditions, robots might be able to act at least as ethically as soldiers, or even outperform them (Lucas 2014). They could minimize collateral damage and hence improve the protection of civilians, due to their ability to process large amounts of information quickly for the selection of targets, a higher precision in engaging them, and the absence of human emotions such as fear and stress (Arkin 2009). Moreover, as Schmitt (2013) argues, even if LAWS would never be able to fulfil the principle of distinction, it could still be legal to use them in uninhabited spaces and against non-human targets, thereby decreasing the risks for soldiers on the battlefield. Henceforth, considering that increasingly autonomous weapons systems could improve the protection of both combatants and civilians, it would be counter-intuitive to pre-emptively ban them.

Drafting a regulatory treaty would necessitate a nuanced review of the legality of different features of the evolving technology and the potential contexts of use. Article 36 of the first Additional Protocol to the Geneva Conventions of 1977 sets out the formal review procedure for 'new weapon, means or method of warfare', obliging states to 'determine whether a weapon's employment would, in some or all circumstances, be prohibited by international law'.[2] However, so far, only six of the two-dozen countries possessing armed drones have initiated a review procedure, and the results of even fewer countries are publicly available (Foster and Haden-Pawlowski 2015). For that reason, Lewis (2015) suggests a more concrete regulatory framework for LAWS with five distinct categories in which the legality of LAWS needs to be monitored, assessed, and possibly restricted. Among these categories are the characteristics of the weapons technology, the environment in which they are used, the opposing forces against which they are directed, and the degree of residual human control (Lewis 2015: 1322).

There are several examples of regulatory arms control treaties from which lessons for the regulation of LAWS could be drawn. Particularly relevant to the present challenge is the amended second Additional Protocol to the CCW, on 'Prohibitions or Restrictions on the Use of Mines, Booby-Traps and Other Devices'. The Protocol restricts inter alia several technical features of landmines, and the targets which they may engage.[3] In contrast to the Ottawa Convention, the additional Protocol was also endorsed by states that were not willing to entirely ban, but still to regulate certain features and applications of landmines. Based on the experience of regulating landmines and in light of the critical position of key states like the US and Israel towards a ban, Lewis (2015) argues that a regulatory treaty could be more effective in the case of LAWS.

Both options presented so far suffer from one major weakness: the treaty-making process would be based on a largely predictive analysis of the future technology, and thus would be influenced strongly by the Collingridge Dilemma. Logically, this analysis could only provide an incomplete assessment of the potential dangers of LAWS and their precursors. A prohibitory treaty based on such an analysis could then prematurely give away the potentially positive effects of increasingly autonomous systems in both the military and civilian realm. Critics even argue that a ban would run counter to its self-proclaimed objective, by prohibiting a technology that could potentially improve the protection of civilians in war. A regulatory treaty, on the other hand, could be rendered obsolete quickly, if the provisions were not specific enough and the technology developed further around them. A third regulatory approach, presented below, tries to circumvent the 'prediction problem' by postulating the gradual establishment of norms and best practices along with the incremental evolution of increasingly autonomous technologies.

The norms approach: developing norms and best practices incrementally

The approach proposed by the legal scholars Kenneth Anderson and Andrew Waxman (2013) stipulates the development of a set of legal and ethical norms and best practices for the design,

manufacturing, and use of increasingly autonomous weapons systems. Like the proponents of a regulatory treaty, Anderson and Waxman reject the assumption that fully autonomous systems are illegal per se. They disagree however on the utility of a preventive and binding regulatory treaty. Instead, they contend that norms have to evolve as incrementally as the technology itself.

Anderson and Waxman's model stretches over two levels. First, norms and best practices have to be created and applied by a leading state on the national level. According to the scholars, norms in this context do not refer to customary law but imply 'widely held expectations about legally or ethically appropriate conduct' (Anderson and Waxman 2013: 22). The baseline for these norms should be the principles of distinction and proportionality as enshrined in international humanitarian law. In a second step, once these norms have been fleshed out and established nationally, they should be transferred to the international level and eventually be adopted also by other states. However, Waxman and Anderson leave open whether such rules should be binding or not. As a pioneering state in the development and use of autonomous systems, the United States should take a leading role in the evolution, promotion, and application of these norms. By applying the standards to its own weapons development and restraining it accordingly, it could set a formative example for other states contemplating the acquisition and employment of LAWS.

While the norms approach does not fall into the trap of predictive regulation, it can be criticized on other grounds. First, the technology might outpace the establishment of norms and best practices. As pointed out by Collingridge, once the technology is employed and potential benefits become visible, it will be difficult to create norms for its use retroactively. Moreover, it could be challenging for the United States to act as a 'norm entrepreneur' in the case of autonomous weapons systems, after having been reluctant so far to take any regulative measures regarding armed drones, despite increasing international pressure.

Conclusion

Autonomous weapons have not been developed yet to a point where lethal decision-making without any human intervention is possible. Only precursors of such technology exist, some of which provide a glimpse into the future development trajectory. The huge increase in interest in different aspects of this topic is mirrored by the amount of scholarly work that has started to appear in the last few years – most of it outside of Security Studies, however. In general, the policy debate is most strongly informed by legal scholars at the moment.

Across all the texts, one aspect that has received surprisingly little attention is the role of private technology companies. Although some technical experts were invited to the past meetings on LAWS at the UN, no observable dialogue on the issue has taken place with representatives of private technology firms. This is astonishing in view of the strong dual-use character of the software and hardware components used in increasingly autonomous systems.

While dual-use technologies are not new to the field of arms control, autonomous systems will create specific challenges in this regard. Progress in the field of autonomy is mainly driven by innovations in the civilian realm, ranging from self-driving cars to household robots. Many of the components used in these systems can often, with only slight modifications, be used for military applications. In contrast to state-driven research and development projects in the armaments sector, innovative products from private companies specializing in civilian technologies become available on the market more quickly, and will therefore also play an increasing role in autonomous technologies used in the military realm (Francois 2015). Including private technology companies that are at the forefront of developing future autonomous technologies in the process of finding a suitable regulatory framework for LAWS could make predictions about technological risks more reliable and hence a treaty regime more stable and legitimate.

Private technology firms will also inevitably be affected by any restrictions regarding the development and sale of certain autonomous technologies or specific features thereof. This inference has two implications that require further consideration: first, the potential effects of regulatory measures on civilian technology firms are certainly influential in shaping a country's preference for one or the other regulatory approach. South Korea, as an important technology exporting country, stressed for example that a regulatory regime must not affect the civilian development of autonomous technologies (Campaign to Stop Killer Robots 2015). Second, in the case of any regulatory approach, the narrowing gap between civilian and military autonomous technologies will give the private industry an important role to play in the verification of treaty commitments, as well as in avoiding the proliferation of those technologies to non-state actors.

Notes

1 http://www.tandfonline.com/loi/smil20#.VnF5KyurX54
2 https://www.icrc.org/ihl/WebART/470-750045?OpenDocument
3 https://www.icrc.org/ihl/0/e32aba4fd82027edc125641f002d20f6?OpenDocument

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