

AUTONOMOUS SYSTEMS, PRIVATE ACTORS, OUTER SPACE AND WAR: LESSONS FOR ADDRESSING ACCOUNTABILITY CONCERNS IN UNCERTAIN LEGAL ENVIRONMENTS

EVE MASSINGHAM* AND DALE STEPHENS†

Developments in technology are creating legal uncertainties concerning questions of accountability under international law, as systems become more autonomous and the chain of decision-making responsibility less clear.

In outer space, there is a particular reliance on experimental and increasingly autonomous emerging technologies. In this context, the uncertainty regarding liability for adverse outcomes resulting from such systems is compounded by the fact that space, which was once solely the domain of states, has seen a significant rise in use by private actors. Space law has unique rules regarding private actors; it may be fairly asked whether existing space law is too rigid to adequately cover all current activities in outer space and appropriately assign responsibility for their consequences, especially if an incident occurs due to an autonomous system launched by a private actor.

The law of armed conflict is being similarly challenged by new technologies, especially regarding the regulation of weapons, means and methods of warfare and other systems with autonomous functionalities. Although automation in military devices has been around a long time (eg landmines and uncrewed balloons), legal frameworks were not drafted with the full gamut of today's available technology in mind. The result has been extensive debate about how to appropriately assign responsibility, especially when things go wrong with autonomous systems in war.

These parallel issues — attribution of both responsibility for private actors' autonomous space objects and responsibility for the actions of autonomous systems being employed in armed conflict — draw these legal frameworks together. A further connection that will be canvassed is that deployment of such systems to outer space by private actors has the potential to drag states unwittingly into armed conflict.

This article reviews the current state of the law in both outer space and armed conflict and identifies areas where the unique nature of the development and deployment of autonomous systems challenges existing notions of accountability at international law. In seeking to provide some solutions, the paper makes the case for paying greater attention to the added value of domestic laws, the possibilities presented by military diplomacy, as well as asking the question of how collective responsibility principles might best be employed in these domains.

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* Eve Massingham is a Senior Research Fellow at the University of Queensland.

† Dale Stephens is Professor of Law at the University of Adelaide. The authors would like to thank Isabelle Peart and Joanna Jarose for their helpful research assistance. Eve's work receives funding from the Australian Government through the Defence Cooperative Research Centre for Trusted Autonomous Systems. The views and opinions expressed in the paper are those of the authors, and do not necessarily reflect the views of the Australian Government or any other institution.

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I INTRODUCTION

Despite the focus of the *Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies* ('OST') being on the use of outer space for 'peaceful purposes'¹ and despite the 'fragile peace of space that has been sustained for the past 50-plus years',² concern regarding the use of space is not new. Attention is turning to the phenomenon of armed conflict in space³ and specifically to how the laws of armed

¹ *Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies*, opened for signature 27 January 1967, 610 UNTS 205 (entered into force 10 October 1967) Preamble para 2 ('OST'). See also regarding 'maintaining international peace and security', the use of the moon and other celestial bodies 'exclusively for peaceful purposes' and regarding 'peaceful exploration' of outer space: at arts 3, 4, 9, 11.

² Melissa de Zwart and Dale Stephens, 'The Space (Innovation) Race: The Inevitable Relationship between Military Technology and Innovation' (2019) 20(1) *Melbourne Journal of International Law* 1, 4.

³ Bleddyn Bowen, 'Space Oddities: Law, War and the Proliferation of Spacepower' in James Gow et al (eds), *Routledge Handbook of War, Law and Technology* (Routledge, 2019) 265; Stephan Hobe, 'The Meaning of "Peaceful Purposes" in Article IV of the Outer Space Treaty' (2015) 40 *Annals of Air and Space Law* 9; Dale Stephens, 'Increasing Militarization of Space and Normative Responses' in R Venkata Rao, V Gopalakrishnan and Kumar Abhijeet (eds), *Recent Developments in Space Law: Opportunities and Challenges* (Springer, 2017) 91.

conflict ('LOAC') interact with space law,⁴ noting that LOAC applies whenever there is armed conflict, including in space.⁵

Concerns surrounding outer space and military applications of technological advances also have a significant history. As early as the 1950s, authors were identifying legal issues surrounding the use of new technologies in outer space,⁶ many of these having military applications. However, the rapidity and scale of modern technological developments have made these conversations more pressing, and legal issues arising from the use of emerging technologies in space and armed conflict are the subject of specific recent attention and concern.⁷ This is amplified for systems involving autonomous⁸ functionality, which invoke further complications surrounding attribution of activity and, in LOAC, the lawfulness of new 'means and methods of warfare'.⁹

In addition, the ability of non-state entities, such as private companies, to enter the playing field has dramatically transformed the use of space. There has been a significant shift towards the civilian market being the primary source of technological innovation in this field, such that states are increasingly becoming purchasers rather than developers of new technology. For example, private

⁴ Dale Stephens and Cassandra Steer, 'Conflicts in Space: International Humanitarian Law and Its Application to Space Warfare' (2015) 40 *Annals of Air and Space Law* 71; Dale Stephens, 'The International Legal Implications of Military Space Operations: Examining the Interplay between International Humanitarian Law and the Outer Space Legal Regime' (2018) 94 *International Law Studies* 75; Jack Mawdsley, 'Applying Core Principles of International Humanitarian Law to Military Operations in Space' (2020) 25(2) *Journal of Conflict and Security Law* 263.

⁵ *OST* (n 1) art III; *Legality of the Threat or Use of Nuclear Weapons (Advisory Opinion)* [1996] ICJ Rep 226, 259 [86] ('*Nuclear Weapons (Advisory Opinion)*'); Office of the General Counsel, Department of Defense, *Department of Defense Law of War Manual* (Manual, December 2016) 9 ('*US Law of War Manual*'); Yoram Dinstein and Arne Willy Dahl, *Oslo Manual on Select Topics of the Law of Armed Conflict: Rules and Commentary* (Springer, 2020) 3.

⁶ See, eg, Jacek Machowski, 'The Legal Status of Unmanned Space Vehicles' in Andrew G Haley and Welf Heinrich (eds), *Second Colloquium on the Law of Outer Space* (Springer, 1960) 111; Teodoro D Regala, 'Legal Problems Arising from the Use of Unmanned Earth Satellites' (1958) 33(5) *Philippine Law Journal* 645.

⁷ George Sariak, 'Between a Rocket and a Hard Place: Military Space Technology and Stability in International Relations' (2017) 15(1) *International Journal of Space Politics and Policy* 51; de Zwart and Stephens (n 2).

⁸ We use autonomy here in the sense of detailing the relationship(s) between a human and an artificial system. 'Autonomy is task-specific in that a system may be autonomous with respect to some of its functions but not others. Autonomy is a continuum in that a particular function of a system may be more or less autonomous': 'Autonomy', *The University of Queensland Australia* (Web Page, 2 October 2020) <<https://law.uq.edu.au/research/future-war/autonomy>>, archived at <<https://perma.cc/3YJZ-HVES>>. See also the observation of Tim McFarland that autonomy

is not a term selected by lawyers or philosophers; it was selected by scientists and engineers to describe a desired outcome of their work on software and hardware systems. It is a property of a technological system, a degree of which has been achieved in some systems in use today and greater degrees of which are the goal of research and development programs.

Tim McFarland, 'The Concept of Autonomy' in Rain Liivoja and Ann Väljataga (eds), *Autonomous Cyber Capabilities under International Law* (Cooperative Cyber Defence Centre of Excellence, 2021) 12, 13–14.

⁹ *Protocol Additional to the Geneva Conventions of 12 August 1949, and Relating to the Protection of Victims of International Armed Conflicts (Protocol I)*, opened for signature 8 June 1977, 1125 UNTS 3 (entered into force 7 December 1978) art 36 ('*API*').

company ‘Made in Space Inc’ has been contracted by National Aeronautics and Space Administration (‘NASA’) to produce 3D-printed materials in space,¹⁰ while SpaceX’s ‘Endeavour’ reusable Crew Dragon capsule made its second visit to the International Space Station on NASA’s behalf in April 2021.¹¹ Moreover, consistently with the theme of this article, it is notable that current developments in space technology include autonomously operated machines. Technological progress is making such autonomy necessary as rocket propulsion technology evolves past the human response time¹² and spacecraft navigate outside of the range of Earth signals.¹³ Autonomous craft will increasingly form a key part of human space exploration and utilisation, including potentially during times of armed conflict. The actions of autonomous systems in space — including those of commercial space providers — could theoretically constitute a use of force and drag a relevant state (or states) into a situation of international armed conflict. This possibility emphasises the need for states to find ways to monitor and regulate these activities so as to avoid any such consequence.

This article will first, in Part 2 below, address how space law regulates activities in space with particular reference to new technologies and private actors. In Part 3, it will consider how LOAC regulates autonomy in weapons systems with a specific look at the questions of accountability for autonomous weapons systems. In Part 4, it will consider broad issues of accountability in space and assess how the actions of private autonomous craft in space could provoke serious questions about the law to war and the laws in war. Finally, in Part 5, an assessment will be made on how to effectively address the gaps, uncertainties and ambiguities highlighted in the paper thus far concerning the nature of autonomous systems in space as against the legal regimes examined.

II THE LAW APPLICABLE IN OUTER SPACE IS CHALLENGED BY NEW TECHNOLOGIES AND THE PROLIFERATION OF PRIVATE ACTORS

Human activity in outer space is principally regulated by the *OST* and four additional space treaties covering rescue (and return) of astronauts,¹⁴ liability for

¹⁰ Matthew Weinzierl and Mehak Sarang, ‘The Commercial Space Age is Here’, *Harvard Business Review* (online, 12 February 2021) <<https://hbr.org/2021/02/the-commercial-space-age-is-here>>, archived at <<https://perma.cc/5L34-78TV>>.

¹¹ Chelsea Gohd, ‘SpaceX’s First Reused Crew Dragon Docks at Space Station with Four Crew-2 Astronauts’, *Space.com* (Web Page, 24 April 2021) <<https://www.space.com/spacex-crew-2-dragon-space-station-docking-success>>, archived at <<https://perma.cc/Q4MG-9SRB>>; ‘SpaceX Operations’, *NASA* (Web Page, 13 July 2021) <<https://www.nasa.gov/feature/spacex-operations>>, archived at <<https://perma.cc/HYK8-QNE6>>.

¹² Neel V Patel, ‘Are We Making Spacecraft Too Autonomous?’, *MIT Technology Review* (Web Page, 3 July 2020) <<https://www.technologyreview.com/2020/07/03/1004788/spacecraft-spaceflight-autonomous-software-ai/>>, archived at <<https://perma.cc/BQY9-MHAP>>.

¹³ Erdem Turan, Stefano Speretta and Eberhard Gill, ‘Autonomous Navigation for Deep Space Small Satellites: Scientific and Technological Advances’ (2022) 193 *Acta Astronautica* 56, 70.

¹⁴ *Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space*, opened for signature 22 April 1968, 672 UNTS 119 (entered into force 3 December 1968).

damage caused by space objects,¹⁵ registration of objects launched into space¹⁶ and activities of states on the Moon.¹⁷ Critically, the *OST* has a large number of states party, including all major space-faring states such as China, India, Russia and the United States.¹⁸

While the *OST* may be regarded as the ‘Charter’ of the legal regulation of human space activities, and rightly sits at the centre of the space law regime, it is a modest treaty in terms of length, comprising only 17 articles.¹⁹ Moreover, the *OST* contains many provisions that might be considered aspirational and other provisions that some have observed are ‘too general in application, creating doubt as to whether there is in fact a rule of law for outer space’.²⁰ While such an observation may be overstated, it is clear that states have been reticent to invoke *OST* terms²¹ in a way that could inform contemporary meaning as a result of state practice.²² This necessarily creates uncertainties as to the nature of the *OST*’s capacity to deal with emerging issues.

The generality of some of the provisions used in the *OST* has proven prescient. The *OST* did anticipate future human and technical capability by acknowledging that non-state entities may undertake activities in space.²³ In 1967 that was quite a significant accommodation given that only states at that time generally had the technical means and financial capacity to conduct space activity. The *OST* was, however, specific in linking the actions of such non-state entities to a state as a ‘national [activity]’ under art VI of the Treaty in a manner that broke new ground concerning traditional requirements for state responsibility.²⁴

The first semi-private venture into space occurred with the launch of an AT&T satellite, Telstar 1, on 10 July 1962.²⁵ However, in the first few decades of human space activity the reach of non-government entities into space was limited. In 1980, for example, there were only nine commercial satellites in operation.²⁶ It

¹⁵ *Convention on the International Liability for Damage Caused by Space Objects*, opened for signature 29 March 1972, 961 UNTS 187 (entered into force 1 September 1972) (‘*Liability Convention*’).

¹⁶ *Convention on Registration of Objects Launched into Outer Space*, opened for signature 12 November 1974, 1023 UNTS 15 (entered into force 15 September 1976) (‘*Registration Convention*’).

¹⁷ *Agreement Governing the Activities of States on the Moon and Other Celestial Bodies*, opened for signature 5 December 1979, 1363 UNTS 3 (entered into force 11 July 1984).

¹⁸ Committee on the Peaceful Uses of Outer Space Legal Subcommittee, *Status of International Agreements Relating to Activities in Outer Space as at 1 January 2022*, Provisional Agenda Item 6, UN Doc A/AC.105/C.2/2022/CRP.10 (28 March 2022) 5–9.

¹⁹ See *OST* (n 1).

²⁰ Icho Kealotswe-Matlou, ‘The Rule of Law in Outer Space: A Call for an International Outer Space Authority’ in Cassandra Steer and Matthew Hersch (eds), *War and Peace in Outer Space: Law, Policy, and Ethics* (Oxford University Press, 2021) 91, 92.

²¹ A notable exception may be China’s recent statements concerning SpaceX constellations that make reference to art VI of the *OST* (n 1) — see below n 38 — but even here the more relevant Article should have been art IX and the issue of ‘potentially harmful interference’.

²² *Vienna Convention on the Law of Treaties*, opened for signature 23 May 1969, 1155 UNTS 331 (entered into force 27 January 1980) art 31(3)(b).

²³ *OST* (n 1) art VI.

²⁴ *Ibid.*

²⁵ ‘July 12, 1962: The Day Information Went Global’, *NASA* (Web Page, 31 January 2018) <<https://www.nasa.gov/topics/technology/features/telstar.html>>, archived at <<https://perma.cc/V5BU-TLP9>>.

²⁶ Christina Isnardi, ‘Problems with Enforcing International Space Law of Private Actors’ (2020) 58(2) *Columbia Journal of Transnational Law* 489, 494.

was not until after the February 2003 Columbia space shuttle tragedy (in which seven lives were lost) — and the NASA space program’s subsequent suspension — that commercial actors in space became more prominent.²⁷ Such a change was intentional. In January 2004, the US Vision for Space Exploration (responding to the aforementioned Columbia disaster) aimed to, inter alia, transform NASA into an organisation that would ‘rely more heavily on private sector space capabilities to support activities in Earth orbit and future exploration activities’.²⁸ In recent years, it is evident that this goal is being realised and private industry is leading the economic and technical charge into space. Hence, of the USD370 billion global space economy in the 2021 calendar year, an estimated 75% was non-government commercial spending, with the vast majority dedicated to navigation and satellite communication technologies.²⁹ This represents an increase of USD85 billion in the annual value of this market since 2016.³⁰ One area of particularly rapid increase has been the conducting of space launches by private commercial enterprise — for example, the US Federal Aviation Administration (‘FAA’) recorded nine licensed commercial launches in 2015, 26 in 2019 and 54 in 2021.³¹

This increase in private space activity has necessarily resulted in more interactions between objects in space. Recent events have highlighted the current congestion problems; for example, it was reported that in late March 2021, two satellites — one belonging to OneWeb and another to SpaceX — passed dangerously close to one another.³² Similarly, the Chinese Government recently highlighted its concerns as to the activities of the privately owned Starlink constellation, claiming that the trajectory of Starlink satellites created safety concerns for astronauts on the China Space Station.³³

With respect to autonomous systems, commercial operators have spacecraft currently in operation that successfully navigate and dock fully autonomously,

²⁷ For a more detailed exploration of the history of private space activity see *ibid* 493–9.

²⁸ National Aeronautics and Space Administration, *The Vision for Space Exploration* (Report, February 2004) 17 <https://www.nasa.gov/pdf/55583main_vision_space_exploration2.pdf>, archived at <<https://perma.cc/ZWH7-EEMJ>>.

²⁹ Euroconsult, ‘Euroconsult Estimates that the Global Space Economy Totaled \$370 Billion in 2021’ (Press Release, 11 January 2022) <<https://www.euroconsult-ec.com/press-release/euroconsult-estimates-that-the-global-space-economy-totaled-370-billion-in-2021/>>, archived at <<https://perma.cc/49AW-XV8Q>>.

³⁰ *Ibid*.

³¹ ‘Commercial Space Data: Licensed Launches’, *Federal Aviation Administration* (Web Page, 4 January 2022) <https://www.faa.gov/data_research/commercial_space_data/>, archived at <<https://perma.cc/ZL83-4ACB>>.

³² Joey Roulette, ‘OneWeb, SpaceX Satellites Dodged a Potential Collision in Orbit’, *The Verge* (Web Page, 10 April 2021) <<https://www.theverge.com/2021/4/9/22374262/oneweb-spacex-satellites-dodged-potential-collision-orbit-space-force>>, archived at <<https://perma.cc/R2KR-23GQ>>.

³³ Committee on the Peaceful Uses of Outer Space, *Information Furnished in Conformity with the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies: Note Verbale Dated 3 December 2021 from the Permanent Mission of China to the United Nations (Vienna) Addressed to the Secretary-General*, UN GAOR, UN Doc A/AC.105/1262 (6 December 2021); Rhoda Kwan and Jon Henley, ‘China Berates US after “Close Encounters” with Elon Musk Satellites’, *The Guardian* (online, 28 December 2021) <<https://www.theguardian.com/science/2021/dec/28/china-complains-to-un-after-space-station-is-forced-to-move-to-avoid-starlink-satellites>>, archived at <<https://perma.cc/WKX5-5LNV>>.

such as the SpaceX Crew Dragon.³⁴ However, already there is a demonstrated possibility for significant issues. For example, several code errors detected during the flight test of the fully autonomous Boeing Starliner capsule in December 2019 resulted in the test being aborted prematurely.³⁵ One of the identified errors impeded the ability of the ground crew to take control of the vehicle, while another prevented a separable module's thrusters from firing correctly.³⁶ NASA has admitted the errors could have had potentially disastrous consequences.³⁷

The 2021 United Nations Outer Space Security Conference recognised that the increasing use and congestion of space means that some resolution needs to be found and included a series of discussions on both binding and non-binding normative prospects for addressing these issues.³⁸ While the need for better space traffic management is a well-recognised goal,³⁹ its absence to date has not halted the increasing presence of private actors in space and the profusion of new technologies, including autonomous systems, that have accompanied this phenomenon.

III THE LAW APPLICABLE IN ARMED CONFLICT IS CHALLENGED BY NEW TECHNOLOGIES, PARTICULARLY THE PROLIFERATION OF AUTONOMOUS SYSTEMS

Like in the space domain, the law has not halted the profusion of new technologies, including autonomous systems for use in situations of armed conflict that constitute 'new weapons, means or methods of warfare'.⁴⁰ The projects and investments of major players in this area are enormous.⁴¹ In the final report of the UN Panel of Experts on Libya, the use of the Turkish STM Kargu-2 loitering lethal autonomous weapons system on 27 March 2020 in Operation PEACE STORM was noted.⁴² The Kargu-2 was said to be 'programmed to attack targets without requiring data connectivity between the operator and the munition'.⁴³ Despite

³⁴ Patel (n 12).

³⁵ Marie Lewis, 'NASA Shares Initial Findings from Boeing Starliner Orbital Flight Test Investigation', *NASA Commercial Crew Program* (Blog Post, 7 February 2020) <<https://blogs.nasa.gov/commercialcrew/2020/02/07/nasa-shares-initial-findings-from-boeing-starliner-orbital-flight-test-investigation/>>, archived at <<https://perma.cc/NN7R-X5XM>>.

³⁶ Ibid.

³⁷ Marina Koren, 'NASA Will Only Tolerate So Much Danger', *The Atlantic* (online, 11 February 2020) <<https://www.theatlantic.com/science/archive/2020/02/boeing-nasa-starliner-software-problems/606361/>>, archived at <<https://perma.cc/227A-X8SS>>.

³⁸ '2021 Outer Space Security Conference,' *United Nations Institute for Disarmament Research* (Web Page) ('2021 OSS Conference') <<https://www.unidir.org/events/2021-outer-space-security-conference>>, archived at <<https://perma.cc/NCH2-92U3>> .

³⁹ See, eg, LTWRC USAFA, 'USSPACECOM Legal Conference Space Traffic Management (Burt, Rathnasabapathy, Stephens, Weeden 5 Apr)' (YouTube, 10 April 2022) <<https://www.youtube.com/watch?v=LDVHVStUBEQ&t=10s>>, archived at <<https://perma.cc/632N-RF9J>>.

⁴⁰ *API* (n 9) art 36.

⁴¹ For a general overview (albeit from 2018) of some of the projects under development and the possibilities, see Paul Scharre, *Army of None: Autonomous Weapons and the Future of War* (WW Norton and Company, 2018).

⁴² *Letter Dated 8 March 2021 from the Panel of Experts on Libya Established Pursuant to Resolution 1973 (2011) Addressed to the President of the Security Council*, UN SCOR, UN Doc S/2021/229 (8 March 2021) 17.

⁴³ Ibid.

commentary at the time that this use was the starting point for ushering in a new era,⁴⁴ this mass proliferation of autonomous systems on the battlefield has not eventuated to date.⁴⁵ However, although there is still a long way to go technologically, and only a few autonomous systems have been deployed to date, the conversation about these systems and the law is in need of resolution.

Conversely to the modest 17 articles of the *OST*, LOAC is comprised of the more than 420 articles found in the *Geneva Conventions* of August 1949 alone.⁴⁶ These are supplemented by the *Additional Protocols*,⁴⁷ as well as a number of specific weapons treaties.⁴⁸ Despite its greater volume, LOAC shares with space law many of the issues identified in Part 2 regarding the law's capacity to deal with emerging issues. We note for completeness that we are discussing the law as it applies to international armed conflicts in this piece given the current space law regime is premised on the understanding that states are unequivocally responsible for the actions of private actors in space, as is discussed further below.

First, the LOAC provisions, whilst detailed in relation to particular matters such as the treatment of protected persons, do exhibit a great deal of generality and scope for application to new technologies. Like the generality of some of the provisions used in the *OST*, this has proven prescient given the development of technologies for use in armed conflict. The generality of art 36 of *Protocol Additional to the Geneva Conventions of 12 August 1949, and Relating to the Protection of Victims of International Armed Conflicts (Protocol I)* ('*API*') discussed below in this Part 3(a), is central to this.⁴⁹

Second, the uncertainty around state responsibility for private acts in space bears consideration in terms of similarities to uncertainties around individual responsibility for the actions of autonomous systems being employed in armed

⁴⁴ Peter Apps, 'How Libya Ushered in the Era of Kamikaze Drones', *The Arab Weekly* (online, 11 June 2021) <<https://thearabweekly.com/how-libya-ushered-era-kamikaze-drones>>, archived at <<https://perma.cc/YD76-WCCX>>.

⁴⁵ During the Russian invasion of Ukraine in 2022 we have not seen the mass of autonomous systems that many would have predicted an interstate war in this decade to have. See, eg, Brendan Walker-Munro 'Drones over Ukraine: Fears of Russian "Killer Robots" Have Failed to Materialise', *The Conversation* (Web Page, 30 March 2022) <<https://theconversation.com/drones-over-ukraine-fears-of-russian-killer-robots-have-failed-to-materialise-180244>>, archived at <<https://perma.cc/SA5L-XU6H>>.

⁴⁶ *Geneva Convention for the Amelioration of the Condition of the Wounded and Sick in Armed Forces in the Field*, opened for signature 12 August 1949, 75 UNTS 31 (entered into force 21 October 1950) ('*GCI*'); *Geneva Convention for the Amelioration of the Condition of Wounded, Sick and Shipwrecked Members of Armed Forces at Sea*, opened for signature 12 August 1949, 75 UNTS 85 (entered into force 21 October 1950) ('*GCI*'); *Geneva Convention relative to the Treatment of Prisoners of War*, opened for signature 12 August 1949, 75 UNTS 135 (entered into force 21 October 1950) ('*GCI*'); *Geneva Convention relative to the Protection of Civilian Persons in Time of War*, opened for signature 12 August 1949, 75 UNTS 287 (entered into force 21 October 1950) ('*GCIV*').

⁴⁷ *API* (n 9); *Protocol Additional to the Geneva Conventions of 12 August 1949, and Relating to the Protection of Victims of Non-International Armed Conflicts (Protocol II)*, opened for signature 8 June 1977, 1125 UNTS 609 (entered into force 7 December 1978) ('*API*'); *Protocol Additional to the Geneva Conventions of 12 August 1949, and Relating to the Adoption of an Additional Distinctive Emblem (Protocol III)*, opened for signature 8 December 2005, 2404 UNTS 261 (entered into force 14 January 2007) ('*API*').

⁴⁸ For a comprehensive listing, see 'Treaties and States Parties', *International Committee of the Red Cross* (Web Page) <<https://ihl-databases.icrc.org/en/ihl-treaties/treaties-and-states-parties>>, archived at <<https://perma.cc/5CSS-CNP3>>.

⁴⁹ *API* (n 9) art 36.

conflict. This accountability uncertainty is discussed below in Part 3(b) in relation to LOAC and in Part 4 for outer space.

A *The Law of Armed Conflict has Always Anticipated Technological Development, but not all the Potential Capabilities of AI-Informed Autonomy are Envisaged by the General rules*

Collectively, the Geneva Conventions and Protocols regulate the means and methods of warfare in such a way as to minimise the impacts of armed conflict on those not or no longer taking part in the hostilities. *API* approaches the question of military technological advancement by anticipating the future development of new ‘means and methods of warfare’ and regulating accordingly.⁵⁰ As was expressed by the delegate from Senegal, Mr Barrc, during the negotiations of *API*, there was a general concern at the time of drafting of the provisions of them becoming ‘out of date in a few years as a result of changes which might subsequently occur in the dangers arising from the development of weapons and methods of fighting’.⁵¹ As a result, *API* art 36 requires states to assess whether or not new means and methods comply with LOAC.⁵² Article 36 is often considered a ‘weapons review’ provision. However, it is important to note that the actual obligation pertains not only to weapons, but also to new ‘means or methods’ of warfare, therefore applying more broadly and including autonomous systems that constitute new means or methods of warfare even if not weapons themselves.⁵³

Article 36 of *API* provides:

In the study, development, acquisition or adoption of a new weapon, means or method of warfare, a High Contracting Party is under an obligation to determine whether its employment would, in some or all circumstances, be prohibited by this Protocol or by any other rule of international law applicable to the High Contracting Party.⁵⁴

A predecessor to this provision, which is even more explicit on the issue of scientific ‘improvement’, can be found in the *St Petersburg Declaration*:

[t]he Contracting or Acceding Parties reserve to themselves to come hereafter to an understanding whenever a precise proposition shall be drawn up in view of future improvement which science may effect in the armament of troops, in order to maintain the principles which they have established, and to conciliate the necessities of war with the laws of humanity.⁵⁵

⁵⁰ *API* (n 9) art 36.

⁵¹ ‘Summary Record of the Seventh Meeting Held on Friday, 15 March 1974 at 3.15 p.m.’ (Official Records of The Diplomatic Conference on the Reaffirmation and Development of International Humanitarian Law Applicable in Armed Conflicts Geneva (1974–1977) vol VIII, CDDH/I/SR.7) 51, 55 [36] <https://tile.loc.gov/storage-services/service/l1/lmlp/RC-records_Vol-8/RC-records_Vol-8.pdf>, archived at <<https://perma.cc/YH7U-YPKD>>.

⁵² *API* (n 9) art 36.

⁵³ For a detailed consideration of what is a ‘weapon, means or method of warfare’ see especially *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) 9 n 17.

⁵⁴ *API* (n 9) art 36.

⁵⁵ *Declaration Renouncing the Use, in Time of War, of Explosive Projectiles under 400 Grams Weight*, opened for signature 29 November 1868, [1901] ATS 125 (entered into force 11 December 1868).

Further, the existence of the Martens Clause⁵⁶ — foreseeing further legal and technological developments and providing civilian protections in relation to their deployment where there is no specific legal regulation — provides an illustration of this general approach to new technologies in the regulation of warfare.

While anticipating new technological developments, it is understandable that the drafters of the laws of war could not have envisaged every possible implication of technological development. It is clear from a review of the drafting history of art 36, including looking to the Official Records of the Diplomatic Conference which resulted in *API*, and the Ad Hoc Committee on Weapons,⁵⁷ that while there was some discussion about types of weapons there was very limited discussion of autonomy, or even automation. Only one delegate made any reference to existing automated systems⁵⁸ — even though, as noted by Eve Massingham elsewhere,⁵⁹ the use of automation has been a part of air warfare tactics and strategy since the 1800s, with uncrewed balloons providing the quintessential example⁶⁰ and automatic naval sea mines being themselves already the subject of a treaty permitting their use.⁶¹

In regard to the future employment of automated technologies, Mr Janzon of Sweden referenced ‘the “automated battlefield” concept, as a more gradual evolution of the present means of combat’, and raised concerns that ‘[t]hose developments could result in the production of increasingly effective and inhumane weapons’.⁶² There was general concern about the ‘uncontrolled’ nature of future technologies, which remains a key concern of many today in regard to

⁵⁶ Until a more complete code of the laws of war is issued, the High Contracting Parties think it right to declare that in cases not included in the Regulations adopted by them, populations and belligerents remain under the protection and empire of the principles of international law, as they result from the usages established between civilized nations, from the laws of humanity, and the requirements of the public conscience.

Hague Convention (II) with respect to the Laws and Customs of War on Land, opened for signature 29 July 1899 (entered into force 4 September 1900) Preamble.

⁵⁷ The Ad Hoc Committee on Weapons functioned throughout the four sessions of the Diplomatic Conference but never made any substantive recommendations. See also Howard Levie, ‘Prohibitions and Restrictions on the Use of Conventional Weapons’ (1998) 70 *International Law Studies* 353, 355.

⁵⁸ In discussions about medical flights Mr Makin of the UK delegation noted the need for the UK’s ‘automatic defence equipment’ to be switched off in order to ensure the safe transit of medical flights: ‘Summary Record of the Forty-Seventh Meeting Held on Saturday, 5 April 1975, at 10.10 a.m.’ (Official Records of The Diplomatic Conference on the Reaffirmation and Development of International Humanitarian Law Applicable in Armed Conflicts Geneva (1974–1977) vol XI, CDDH/II/SR.47) 525, 535 <https://tile.loc.gov/storage-services/service/l1/llmlp/RC-records_Vol-11/RC-records_Vol-11.pdf>, archived at <<https://perma.cc/KD9W-AVHK>>.

⁵⁹ Eve Massingham, ‘Radio Silence: Autonomous Military Aircraft and the Importance of Communication for their Use in Peace Time and in Times of Armed Conflict under International Law’ (2020) 1(1) *Asia Pacific Journal of International Humanitarian Law* 184, 190–1.

⁶⁰ Ian Henderson and Bryan Cavanagh, ‘Unmanned Aerial Vehicles: Do They Pose Legal Challenges?’ in Hitoshi Nasu and Robert McLaughlin (eds), *New Technologies and the Law of Armed Conflict* (TMC Asser Press, 2014) 193, 195.

⁶¹ *Hague Convention (VIII) relative to the Laying of Automatic Submarine Contact Mines*, opened for signature 18 October 1907 (entered into force 26 January 1910).

⁶² ‘Summary Record of the Thirty-Third Meeting Held on Wednesday, 2 June 1976, at 3.15 p.m.’ (Official Records of the Diplomatic Conference on the Reaffirmation and Development of International Humanitarian Law Applicable in Armed Conflicts (1974–1977), vol XVI, CDDH/IV/SR.33) 339, 340 [4]–[5] <https://tile.loc.gov/storage-services/service/l1/llmlp/RC-records_Vol-16/RC-records_Vol-16.pdf>, archived at <<https://perma.cc/SW7F-Z7LV>>.

autonomous systems. Mr Portillo of Venezuela was of the view that there was a need to ensure humanitarian law kept pace with science and technology as applied to the development of new conventional weapons.⁶³ He further suggested recommendations be adopted which act as ‘moral brakes on scientific and technological progress in the field of armaments’ to prevent ‘suffering and misery to present and future generations, and desolation to the ecology’.⁶⁴ Thus, while not completely beyond the contemplation of the Conference delegates, in reading the documents which accompany the Diplomatic Conference it would nonetheless be inaccurate to suggest any real contemplation of the scenarios and the legal implications that we are grappling with today.

Anticipating new weapons systems based upon novel and emerging technologies obviously represents an ongoing challenge to the law. The International Court of Justice has famously opined that LOAC does apply to all armed conflict and all weapons used in such conflict whenever and wherever such conflict occurs.⁶⁵ Hence, however daunting the challenge of applying such a legal framework to technologies which it did not explicitly anticipate, there is an obligation to do so as effectively as possible and to also identify where there may be gaps and uncertainties in the face of both special legal regimes and advances in technology.

B *Autonomous Weapons Systems Could Have Their Own Specific LOAC Regulation, but Uncertainty is Stifling These Discussions and Much of this Relates to Accountability*

Over the last five years there have been specific international discussions about the regulation of one aspect of autonomy in warfare: whether new law is needed to regulate the use of lethal autonomous weapons systems (‘LAWS’). The Group of Governmental Experts on emerging technologies in the area of lethal autonomous weapons systems (‘GGE LAWS’) was formally established in 2016 at the Fifth Review Conference of the Convention on Certain Conventional Weapons.⁶⁶ This came off the back of discussions about the issue within the framework of the Convention on Certain Conventional Weapons and informal

⁶³ ‘Summary Record of the Fifteenth Meeting Held on Friday, 7 March 1975, at 3.20 p.m.’ (Official Records of the Diplomatic Conference on the Reaffirmation and Development of International Humanitarian Law Applicable in Armed Conflicts (1974–1977), vol XVI, CDDH/IV/SR.15) 139, 144 <https://tile.loc.gov/storage-services/service/l1/llmlp/RC-records_Vol-16/RC-records_Vol-16.pdf>, archived at <<https://perma.cc/SW7F-Z7LV>>. See also ‘Summary Record of the Forty-First Plenary Meeting Held on Thursday, 26 May 1977, at 3.10 p.m.’ (Official Records of the Diplomatic Conference on the Reaffirmation and Development of International Humanitarian Law Applicable in Armed Conflicts Geneva (1974–1977), vol VI, CDDH/SR.41(26 May 1977) 141, 167 <https://tile.loc.gov/storage-services/service/l1/llmlp/RC-records_Vol-6/RC-records_Vol-6.pdf>, archived at <<https://perma.cc/93KS-G6FS>>.

⁶⁴ ‘Summary Record of the Twenty-Fourth Meeting Held on Wednesday, 12 May 1976, at 3.5 p.m.’ (Official Records of the Diplomatic Conference on the Reaffirmation and Development of International Humanitarian Law Applicable in Armed Conflicts (1974–1977) vol XVI, CDDH/IV/SR.24) 237, 246 [30] <https://tile.loc.gov/storage-services/service/l1/llmlp/RC-records_Vol-16/RC-records_Vol-16.pdf>, archived at <<https://perma.cc/SW7F-Z7LV>>.

⁶⁵ *Nuclear Weapons (Advisory Opinion)* (n 5) 240 [25].

⁶⁶ ‘Background on LAWS in the CCW,’ *United Nations: Office for Disarmament Affairs* (Web Page) <<https://www.un.org/disarmament/the-convention-on-certain-conventional-weapons/background-on-laws-in-the-ccw/>>, archived at <<https://perma.cc/T4RB-WEDU>>.

meetings of experts in 2014, 2015 and 2016.⁶⁷ The GGE LAWS report to the Sixth Review Conference of the Convention on Certain Conventional Weapons in December 2021 indicated no consensus was able to be reached.⁶⁸ This lack of agreement, even in terms of a report to the Convention on Certain Conventional Weapons, demonstrates the difficulty of navigating these issues. Although there is a clear divide between states who support the use of LAWS and those calling for their outright ban, the real issues lie in the ambiguity in between these two ends of the spectrum: allowing the use of LAWS but ensuring ‘meaningful human control’ of any use of such systems.⁶⁹ Although the GGE LAWS mandate has been extended into 2022,⁷⁰ the future of the process is somewhat unclear.

The GGE LAWS discussions have resulted in the drafting of 11 Guiding Principles on LAWS.⁷¹ The Guiding Principles importantly restate the application of LOAC to the development and use of LAWS;⁷² analysis of the National Commentaries provided in 2020 to the GGE LAWS on this first principle shows that all states agree that LOAC applies to LAWS.⁷³ However, states are divided on the adequacy of the current LOAC framework for dealing with LAWS. Some want to ban them.⁷⁴ This view is supported by groups such as the Campaign to Stop Killer Robots, which is of the view that it is impossible to guarantee that LAWS will comply with the rules of LOAC.⁷⁵ By contrast, Israel, Russia and the US believe the existing LOAC framework is sufficient and that no changes should

⁶⁷ Ibid.

⁶⁸ ‘The Group considered different proposals on how to reflect the deliberations including possible conclusions and recommendations of the Group, but no consensus was reached’: Group of Governmental Experts on Emerging Technologies in the Area of Lethal Autonomous Weapons System, *Report of the 2021 Session of the Group of Governmental Experts on Emerging Technologies in the Area of Lethal Autonomous Weapons Systems*, Agenda Item 7, UN Doc CCW/GGE.1/2021/3 (22 February 2022) [18].

⁶⁹ For an analysis of individual state views, see Brian Stauffer, ‘Stopping Killer Robots: Country Positions on Banning Fully Autonomous Weapons and Retaining Human Control’, *Human Rights Watch* (Web Page, 10 August 2020) <<https://www.hrw.org/report/2020/08/10/stopping-killer-robots/country-positions-banning-fully-autonomous-weapons-and>>, archived at <<https://perma.cc/35WC-2BU8>>.

⁷⁰ ‘2022 Group of Governmental Experts (GGE) on Emerging Technologies in the Area of Lethal Autonomous Weapons Systems (LAWS), First Session’, *United Nations* (Web Page) <<https://indico.un.org/event/37347/>>, archived at <<https://perma.cc/8EKH-SD38>>.

⁷¹ *Meeting of the High Contracting Parties to the Convention on Prohibitions or Restrictions on the Use of Certain Conventional Weapons Which May Be Deemed to Be Excessively Injurious or to Have Indiscriminate Effects*, Agenda Item 15, UN Doc CCW/MSP/2019/9 (13 December 2019) annex III (‘*Guiding Principles Affirmed by GGE*’).

⁷² Ibid annex III.

⁷³ See ‘Convention on Certain Conventional Weapons: Group of Governmental Experts on Lethal Autonomous Weapons Systems (2020)’ *United Nations: Office for Disarmament Affairs* (Web Page) <https://meetings.unoda.org/meeting/62100/documents?f%5B0%5D=document_type_meeting%3ANational%20reports>, archived at <<https://perma.cc/S3GN-B73T>>.

⁷⁴ Algeria, Argentina, Austria, Bolivia, Brazil, Chile, China, Colombia, Costa Rica, Cuba, Djibouti, Ecuador, Egypt, El Salvador, Ghana, Guatemala, Holy See, Iraq, Jordan, Mexico, Morocco, Namibia, Nicaragua, Pakistan, Panama, Peru, Palestine, Uganda, Venezuela and Zimbabwe: Stauffer (n 69).

⁷⁵ ‘Recommendations on the Normative and Operational Framework for Autonomous Weapon Systems’ (Campaign to Stop Killer Robots, June 2021) <<https://documents.unoda.org/wp-content/uploads/2021/06/Campaign-to-Stop-Killer-Robots.pdf>>, archived at <<https://perma.cc/9NNB-PE8M>>.

be made.⁷⁶ Others, such as Austria, take the view that international law needs to be developed to specifically regulate autonomous weapons system ('AWS').⁷⁷

LOAC clearly does apply.⁷⁸ Further, seemingly clear statements are made in the Guiding Principles about humans retaining responsibility for the use of LAWS — rather than the machines themselves⁷⁹ — and the requirement to ensure accountability 'in accordance with international law'.⁸⁰ However, while these statements have been agreed, the meaning behind them and their practical application remain elusive. Debate surrounding definitions and what is in fact required to ensure accountability is ongoing.⁸¹ The key issue without resolution seems to boil down to what is actually required to ensure accountability under current international law.

Some states have sought to provide clarity as to their views on the application of the accountability framework to LAWS and have focused on the retention of 'human control'. The United Kingdom for example has released a policy document detailing that the use of kinetic force 'will always be under human control as an absolute guarantee of human oversight and authority and of accountability'.⁸² Australia has gone so far as to submit to the GGE LAWS process an extensive outline of what it calls its 'System of Control' which it views as allowing 'all weapon systems, including AWS, [to] operate in a lawful and deliberate manner'.⁸³ But of course what constitutes this idea of 'System of

⁷⁶ National commentaries on the 11 guiding principles of the GGE on LAWS: 'Israel Considerations on the Operationalization of the Eleven Guiding Principles Adopted by the Group of Governmental Experts' (Permanent Mission of Israel to the United Nations, 31 August 2020) <<https://documents.unoda.org/wp-content/uploads/2020/09/20200831-Israel.pdf>>, archived at <<https://perma.cc/74FH-SXPP>>; 'Working Paper of the Russian Federation: National Implementation of the Guiding Principles on Emerging Technologies in the Area of Lethal Autonomous Weapons Systems' (1 September 2020) <<https://documents.unoda.org/wp-content/uploads/2020/09/Ru-Commentaries-on-GGE-on-LAWS-guiding-principles1.pdf>>, archived at <<https://perma.cc/S6U5-MYBC>>; 'U.S. Commentaries on the Guiding Principles' (1 September 2020) <<https://documents.unoda.org/wp-content/uploads/2020/09/20200901-United-States.pdf>>, archived at <<https://perma.cc/CSG6-3UC4>>.

⁷⁷ 'Contribution of Austria to the Chair's Request on the Guiding Principles on Emerging Technologies in the Area of LAWS' (Permanent Mission of Austria to the United Nations in Geneva, 1 September 2020) 4 <<https://documents.unoda.org/wp-content/uploads/2020/09/20200901-Austria.pdf>>, archived at <<https://perma.cc/JZ5N-KYWY>>.

⁷⁸ See also Law and the Future of War Research Group, University of Queensland, 'Submission to ADF Concept for RAS 2040'0 (31 July 2020).

⁷⁹ *Guiding Principles Affirmed by GGE*, UN Doc CCW/MSP/2019/9 (n 71) annex III.

⁸⁰ *Ibid.*

⁸¹ See 'Convention on Certain Conventional Weapons: Group of Governmental Experts on Lethal Autonomous Weapons Systems (2022)' (Web Page) ('GGE LAWS 2022') <<https://meetings.unoda.org/ccw/convention-certain-conventional-weapons-group-governmental-experts-2022>>, archived at <<https://perma.cc/55W5-EJPM>>.

⁸² Ministry of Defence, *Joint Doctrine Publication 0–30.2: Unmanned Aircraft Systems* (Report, August 2017) [4.14] <https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/673940/doctrine_uk_uas_jdp_0_30_2.pdf>, archived at <<https://perma.cc/MU2Q-N494>>.

⁸³ Group of Governmental Experts on Emerging Technologies in the Area of Lethal Autonomous Weapons Systems, *Australia's System of Control and Applications for Autonomous Weapon Systems*, Agenda Item 5, UN Doc CCW/GGE.1/2019/WP.2/Rev.1 (26 March 2019) [41].

Control’, ‘human control’ or ‘meaningful human control’, as it has variably been described,⁸⁴ remains unclear.

General analysis on the application of international criminal law to crimes which involve the use of LAWS has been the subject of some scholarship.⁸⁵ James Kraska investigates this specifically from the perspective of command responsibility.⁸⁶ How an autonomous weapon would be dealt with in the context of an international criminal trial is an inquiry recently undertaken by Massingham and Simon McKenzie.⁸⁷ In acknowledging the challenges presented by a case involving the employment of an autonomous weapon in a factual situation giving rise to a trial before the International Criminal Court, it is noted that proving the requisite mental element of intent will be difficult, but that existing systems within the legal framework — such as the weapon review process — would be essential to allow operators to understand the weapon and how they can lawfully use it.⁸⁸ Others have considered the weapons review process mentioned above, and how that will operate in the context of an autonomous weapons system.⁸⁹ Moral analysis has also been given considerable attention.⁹⁰ Although states’ views have been put on the table through the LAWS GGE process, much of these have not addressed these issues in any detail.⁹¹ These are all topics that need further consideration by a greater number of states.

⁸⁴ See, eg, Kingdom of the Netherlands, ‘National Commentary by the Kingdom of the Netherlands Regarding the National Interpretation and Implementation of the Guiding Principles Affirmed by the Group of Governmental Experts on Emerging Technologies in the Area of Lethal Autonomous Weapons System’ (Kingdom of Netherlands, 2020). See also Richard Moyes, ‘Systems That Cannot be Effectively Controlled’ (Policy Commentary, Article 36, May 2021) 1 <<https://article36.org/wp-content/uploads/2021/06/May-2021-Background-paper-Autonomous-Weapons-System-Control-Ricard-Moyes-Article-36.pdf>>, archived at <<https://perma.cc/96A4-E6R8>>. There has also been academic discussion on this point: see, eg, Rebecca Crotoof, ‘A Meaningful Floor for “Meaningful Human Control”’ (2016) 30(1) *Temple International and Comparative Law Journal* 53; Matthew T Miller, ‘Command Responsibility: A Model for Defining Meaningful Human Control’ (2021) 11(2) *Journal of National Security Law and Policy* 533.

⁸⁵ Stuart Casey-Maslen, ‘Autonomous Weapons Systems and International Criminal Law’ in Stuart Casey-Maslen et al (eds), *Drones and Other Unmanned Weapons Systems under International Law* (Brill Nijhoff, 2018) 217.

⁸⁶ James Kraska, ‘Command Accountability for AI Weapon Systems in the Law of Armed Conflict’ (2021) 97 *International Law Studies* 407.

⁸⁷ Eve Massingham and Simon McKenzie, ‘Testing Knowledge: Weapons Reviews of Autonomous Weapons Systems and the International Criminal Trial’ in Emma Palmer et al (eds), *Futures of International Criminal Justice* (Routledge, 2021) 177.

⁸⁸ *Ibid* 186, 188.

⁸⁹ See Damian P Copeland, ‘Legal Review of New Technology Weapons’ in Hitoshi Nasu and Robert McLaughlin (eds), *New Technologies and the Law of Armed Conflict* (TMC Asser Press, 2014) 43. See also Netta Goussac, ‘Safety Net or Tangled Web: Legal Reviews of AI in Weapons and War-Fighting’, *Humanitarian Law and Policy* (Blog Post, 18 April 2019) <<https://blogs.icrc.org/law-and-policy/2019/04/18/safety-net-tangled-web-legal-reviews-ai-weapons-war-fighting/>>, archived at <<https://perma.cc/3VQ6-8LGG>>.

⁹⁰ See, eg, Deane-Peter Baker, ‘The Awkwardness of the Dignity Objection to Autonomous Weapons’, *The Strategy Bridge* (Web Page, 6 December 2018) <<https://thestrategybridge.org/the-bridge/2018/12/6/the-awkwardness-of-the-dignity-objection-to-autonomous-weapons>>, archived at <<https://perma.cc/E6RW-LEEE>>.

⁹¹ See, eg, GGE LAWS 2022 (n 81); ‘Convention on Certain Conventional Weapons: Group of Governmental Experts on Lethal Autonomous Weapons Systems (2021)’ (Web Page) <<https://meetings.unoda.org/ccw/convention-certain-conventional-weapons-seventh-group-governmental-experts-2021>>, archived at <<https://perma.cc/5ARD-HUBY>>.

As well as individual criminal responsibility for violations of LOAC, states have specific responsibilities under LOAC. Common art 1 of the *Geneva Conventions* is one source of responsibility, which provides that states have an obligation to respect and ensure respect for the law.⁹² Additionally, some specific provisions place responsibility directly on states for the treatment of certain individuals or groups of individuals, such as prisoners of war and protected persons. For example, art 57 of the *Geneva Convention relative to the Treatment of Prisoners of War* designates '[t]he Detaining Power, the military authorities and the commander of the camp' as 'entirely responsible for the maintenance, care, treatment ... of ... prisoners of war'.⁹³

Of particular note are art 3 of the *International Convention Concerning the Laws and Customs of War on Land (Hague IV)* and art 91 of *API*, which provide that a state is responsible for 'all acts committed by persons forming part of its armed forces'.⁹⁴ This is the LOAC-specific version of the principle of state responsibility at international law. The rules of state responsibility provide that a state is responsible for its internationally wrongful acts and those that are attributable to it.⁹⁵ Rule 149 of the Customary International Humanitarian Law study, completed by the International Committee of the Red Cross ('ICRC'), notes this principle in relation to violations of LOAC, and the ICRC notes the military manuals of Argentina, Canada, Columbia, Germany, Netherlands, New Zealand, Nigeria, Russia, Spain, Switzerland, UK, US and Yugoslavia as supporting state practice for this point.⁹⁶ Although, as Dieter Fleck points out, there have been a number of challenges for those seeking compensation for acts committed by state armed forces, there is evidence of a move towards victims of violations being able to seek reparations under this principle.⁹⁷

It is not clear how state responsibility would work in the case of the use of an AWS. Thompson Chengeta has articulated ways in which a state would assume responsibility for the actions of an AWS using the wording of an AWS '[ending] up violating protected rights'.⁹⁸ However, this itself seems to accept that the AWS is the entity that violates the rights, rather than the user or person making the decision to use it in the circumstances. As Michael Schmitt observes, quoting Seneca in his response to the *Losing Humanity: The Case against Killer Robots* Human Rights Watch report, it is not the sword that does the killing but rather the

⁹² See generally Eve Massingham and Annabel McConnachie (eds), *Ensuring Respect for International Humanitarian Law* (Routledge, 2020).

⁹³ *GCIII* (n 46) art 57.

⁹⁴ *International Convention Concerning the Laws and Customs of War on Land (Hague IV)*, opened for signature 18 October 1907, [1910] ATS 8 (entered into force 26 January 1910) art 3.

⁹⁵ *Report of the International Law Commission on the Work of its Fifty-Third Session*, UN GAOR, 56th sess, Supp No 10, UN Doc A/56/10 (23 April – 1 June 2001 and 2 July – 10 August 2001) ch IV pt E(1) arts 1, 2 ('*Draft Articles on State Responsibility*').

⁹⁶ Jean-Marie Henckaerts and Louise Doswald-Beck, *Customary International Humanitarian Law* (Cambridge University Press, 2005) vol 1, 530–1.

⁹⁷ Dieter Fleck, 'International Accountability for Violations of the *Ius in Bello*: The Impact of the ICRC Study on Customary International Humanitarian Law' (2006) 11(2) *Journal of Conflict and Security Law* 179, 185.

⁹⁸ Thompson Chengeta, 'Accountability Gap: Autonomous Weapon Systems and Modes of Responsibility in International Law' (2016) 45(1) *Denver Journal of International Law and Policy* 1, 47.

person who wields it.⁹⁹ The connection between human and machine is just one of the many conundrums when it comes to working out how the law should deal with accountability for the use of an AWS.

IV THERE ARE UNANSWERED QUESTIONS ABOUT ACCOUNTABILITY FOR ACTIONS IN OUTER SPACE

As discussed in Part 3 above, there is considerable debate surrounding legal accountability for AWS. When applied to space, these uncertainties are amplified. This is due not only to the specific legal regime that applies to space, but also to the very question of what a weapon in space is. Hence, where a state military force deliberately deploys a weapon, say for example, an autonomous ‘space mine’ that explodes when a lawful enemy target is in the vicinity, or fires a missile directly at a space object in orbit, then standard LOAC targeting questions such as distinction, precautions, proportionality and constant care are all raised and can be addressed in a relatively straightforward manner (noting of course the unique physical properties of space). However, what happens when an autonomous system such as a maintenance satellite with a robotic arm¹⁰⁰ ‘decides’ to attack another satellite that is being operated by another state in space by crushing that satellite, or pushing it out of its carefully calibrated orbit? Moreover, what if the target satellite is part of the nuclear early warning system of another state? What if the maintenance satellite is owned and operated by a private company and not a state, and the purpose for the operation of the now rogue satellite was entirely commercial and peaceful? Does that make a difference? With satellites in full orbit travelling at speeds of up to approximately 28,000 km/h,¹⁰¹ there is a constant risk of catastrophic damage via collision. However, that does not make every space object — including an autonomous satellite or other space object — a weapon. The issue of what is a weapon or not in space has been the subject of much discussion and controversy.¹⁰² Issues of intended purpose obviously impact upon

⁹⁹ Michael N Schmitt, ‘Autonomous Weapon Systems and International Humanitarian Law: A Reply to the Critics’, *Harvard Law School National Security Journal* (Feature, 5 February 2013) <<https://harvardnsj.org/2013/02/autonomous-weapon-systems-and-international-humanitarian-law-a-reply-to-the-critics/>>, archived at <<https://perma.cc/9XEA-GQNB>>.

¹⁰⁰ Theresa Hitchens, ‘China’s SJ-21 “Tugs” Dead Satellite out of GEO Belt: Trackers’, *Breaking Defense* (online, 26 January 2022) <<https://breakingdefense.com/2022/01/chinas-sj-21-tugs-dead-satellite-out-of-geo-belt-trackers/>>, archived at <<https://perma.cc/2U3R-6SC8>>.

¹⁰¹ See ‘Types of Orbits’, *The European Space Agency* (Web Page, 30 March 2020) <https://www.esa.int/Enabling_Support/Space_Transportation/Types_of_orbits>, archived at <<https://perma.cc/5N9U-NZ4M>>.

¹⁰² See, eg, response by the US, France and the UK to the proposed ‘No First Placement’ resolution by Russia, indicating

[i]n space, any object with maneuvering [sic] capabilities can in theory be used for offensive purposes. Without a common understanding of what we mean by a space weapon, this resolution would increase mistrust or misunderstanding with regard to the activities and intentions of States.

a decision to designate a ‘weapon’, but in space there is much more capacity to re-purpose any space object in orbit to achieve a military effect through kinetic means, hence making the task of designation more problematic.

These questions and this context are very real, and a literal reading of the *OST* and understanding of international space law provides very uncomfortable answers concerning the ease with which public *and* private actions in space, including those by autonomous systems, can constitute an ‘armed attack’ and thus potentially start an armed conflict. This Part will outline and explore the legal framework that creates this uneasy conclusion.

In approaching the question of accountability for actions in space, it must first be understood that several international law principles applicable in a terrestrial context either do not apply to outer space or have been significantly modified in their application. Hence, for example, there is no sovereign territory in outer space.¹⁰³ Given the reliance on concepts such as territory and associated sovereignty as the basis for much contemporary international law, there is a need to reconsider the way such law may apply in space. Similarly, it is also clear that space objects have no ‘nationality’. Accordingly, there is no equivalent provision of art 91 of the *United Nations Convention on the Law of the Sea*¹⁰⁴ or art 6 of the 1919 *Convention Relating to the Regulation of Aerial Navigation*,¹⁰⁵ which both establish the nationality of a ship or aircraft based upon a territorial connection. Consequently, there is no ‘flag state’ for the purposes of space objects.

That is not to say that states don’t have legal interests in a space object. Article VIII of the *OST*, for example, does recognise that the state of registration has the capacity to exercise jurisdiction, although this is not how nationality is traditionally understood under international law with respect to ships and aircraft.¹⁰⁶ Instead, the space law regime establishes multiple avenues of liability and responsibility for space objects. Hence a state that is not the ‘State of Registration’, but rather a ‘Launching State’, does still have a legal interest in the relevant space object based upon art VII of the *OST* and the *Convention on the*

US Mission Geneva, ‘Explanation of Vote in the First Committee on Resolution: L.50, “No First Placement of Weapons in Outer Space”’, *US Mission to International Organizations in Geneva* (Web Page, 6 November 2018) <<https://geneva.usmission.gov/2018/11/06/explanation-of-vote-in-the-first-committee-on-resolution-l-50-no-first-placement-of-weapons-in-outer-space/>>, archived at <<https://perma.cc/2K63-LJ58>>; ‘given the dual-use nature of many space systems, it is impossible to define a “weapon in space”, which may lead to legal divergence and opening the door to the international evasion of legal obligations’: US Mission Geneva, ‘U.S. Remarks for Conference on Disarmament Subsidiary Body 3: Prevention of an Arms Race in Outer Space’, *US Mission to International Organizations in Geneva* (Web Page, 22 March 2022) <<https://geneva.usmission.gov/2022/03/22/cd-prevention-of-an-arms-race-in-space/>>, archived at <<https://perma.cc/W5NA-8SYU>>; discussing the permutations of space-to-space co-orbital anti-satellite and concluding ‘unless one takes a rather narrow definition of space weapons that excludes space-to-space kinetic forms of attack, space has already been weaponized’: Todd Harrison, *International Perspectives on Space Weapons* (Report, May 2020) 3–8; Bill Boothby, ‘Space Weapons and the Law’ (2017) 93 *International Law Studies* 179, 182–4.

¹⁰³ *OST* (n 1) art II.

¹⁰⁴ *United Nations Convention on the Law of Sea*, opened for signature 10 December 1982, 1833 UNTS 396 (entered into force 16 November 1994) art 91.

¹⁰⁵ *Convention Relating to the Regulation of Aerial Navigation*, signed 13 October 1919, 11 LNTS 173 (entered into force 1 June 1922) art 6.

¹⁰⁶ See *OST* (n 1) art VIII.

International Liability for Damage Caused by Space Objects ('*Liability Convention*').¹⁰⁷ In fact, the *Liability Convention* makes it plain that up to four different states, as 'Launching States', may be concurrently liable for the space object based upon criteria of whether the state launches, procures the launch, and/or allows its territory or its facility to be used for a launch (though the *Convention on Registration of Objects Launched into Outer Space* does require that only one of the Launching States be the State of Registration).¹⁰⁸ In addition, a state may not be the State of Registration or indeed a Launching State but may have a contemporaneous interest because it is the legal owner of the space object. This framework necessarily means that accountability for space objects is both broad and somewhat uncertain.

As noted in Part 2, the ability of non-state entities to enter the playing field has dramatically transformed the use of space. This is central to the whole combined question of accountability, autonomous systems and LOAC because unlike under normal rules of international law, states are unequivocally responsible for the actions of their private companies in space irrespective of issues of fault, intention or any other vitiating factor on the part of the state. Hence, art VI of the *OST* provides that:

States Parties to the Treaty shall bear international responsibility for national activities in outer space, including the moon and other celestial bodies, whether such activities are carried on by governmental agencies or by non-governmental entities, and for assuring that national activities are carried out in conformity with the provisions set forth in the present Treaty. The activities of non-governmental entities in outer space, including the moon and other celestial bodies, shall require authorization and continuing supervision by the appropriate State Party to the Treaty. When activities are carried on in outer space, including the moon and other celestial bodies, by an international organization, responsibility for compliance with this Treaty shall be borne both by the international organization and by the States Parties to the Treaty participating in such organization.¹⁰⁹

Note in particular the reference to 'non-governmental entities' and the imposition of direct responsibility upon States for these entities. This provision reflects a compromise between the Union of Soviet Socialist Republics and the US at the time of negotiation.¹¹⁰ The USSR was insistent that only states would have the entitlement to venture into space whereas the US foresaw that private non-state entities would one day have a role in space.¹¹¹ Article VI recognises the right of non-governmental entities, such as companies, to undertake space activities but imposes a strict connection of responsibility upon states for such activities where they constitute a 'national [activity]'.¹¹² To date, the definition of

¹⁰⁷ See generally *Liability Convention* (n 15).

¹⁰⁸ *Ibid* art I(c); *Registration Convention* (n 16) art II.

¹⁰⁹ *OST* (n 1) art VI.

¹¹⁰ See P Morozov, *Letter Dated 16 June 1966 from the Permanent Representative of the Union of Soviet Socialist Republics to the United Nations Addressed to the Secretary-General*, UN GAOR, 21st sess, UN Doc A/6352 (16 June 1966) 3 art VI.

¹¹¹ See, eg, Committee on the Peaceful Uses of Outer Space Legal Sub-Committee, *Summary Record of the Seventeenth Meeting*, UN Doc A/AC.105/C.2/SR.17 (27 June 1963) 7; Committee on the Peaceful Uses of Outer Space Legal Sub-Committee, *Record of the Twentieth Meeting*, UN Doc A/AC.105/C.2/SR.20 (27 June 1963) 12.

¹¹² *OST* (n 1) art VI.

‘national activity’ has been interpreted broadly and has been asserted to include all activities conducted by a state’s nationals or from national territory.¹¹³ There is an obligation for states to authorise and supervise non-governmental entities and this is usually manifested through applicable domestic law and licensing requirements.¹¹⁴ However, this does not mean that a state may evade its international responsibility in circumstances where a non-governmental entity fails to comply with such a licensing structure; the *OST* is clear that the state will retain responsibility in all circumstances.

As outlined in the introduction of this Part, the already difficult questions concerning legal accountability for autonomous systems under LOAC are amplified in space. Hence, if a private company that is registered in State A develops an autonomous system that is carried into space by a company registered in State B, then there is already a potential dispute as to who is ‘really’ responsible if the autonomous system malfunctions, say in some kind of navigational error, causing a collision with and damage to a space object of State C. Normal attribution issues concerning the extent of ‘effective control’¹¹⁵ or authorisation under state law¹¹⁶ that exist under general international law do not, prima facie, apply because the *lex specialis* regime of space law imposes responsibility directly. Hence, it may be that States A and B are both responsible and, in this case, liable under international law for the autonomous system.

The definition of a ‘space object’ is contained in the *Liability Convention* as including ‘component parts of a space object as well as its launch vehicle and parts thereof’, and similar elements are included in the definition in the *OST*.¹¹⁷ As to the ‘space object’ itself, it has been argued that it comprises ‘any man-made object which is at least attempted to be physically brought into outer space’.¹¹⁸ Accordingly, an autonomous system can be a ‘component’ of a space object and hence a ‘space object’.

A *Accountability for Private Actions, Use of Force and LOAC*

Given the unique way space law imposes responsibility there would appear to be theoretical scope for an autonomous system to use force in manner that crosses both the art 2(4) *Charter of the United Nations* (‘*UN Charter*’) prohibition¹¹⁹ and comes within the definition of an international armed conflict under common art 2 of the *Geneva Conventions*.¹²⁰ This is the case even if such a system is being employed by a private company, by virtue of art VI of the *OST*.¹²¹

¹¹³ *Recommendations on National Legislation Relevant to the Peaceful Exploration and Use of Outer Space*, GA Res 68/74, 68th sess, 65th plen mtg, Agenda Item 50, UN Doc. A/68/74 (16 December 2013) 2 para 2.

¹¹⁴ Irmgard Marboe, ‘National Space Law’ in Frans von der Dunk and Fabio Tronchetti (eds), *Handbook of Space Law* (Edward Elgar, 2015) 127, 131–3, 139–78.

¹¹⁵ *Military and Paramilitary Activities in and against Nicaragua (Nicaragua v United States of America) (Merits)* [1986] ICJ Rep 14, 64–5 [115] (‘*Nicaragua*’); *Draft Articles on State Responsibility* (n 95) art 8.

¹¹⁶ *Draft Articles on State Responsibility* (n 95) art 5.

¹¹⁷ *Liability Convention* (n 15) art I(d); *OST* (n 1) arts VII, VIII.

¹¹⁸ Frans von der Dunk, ‘International Space Law’ in Frans von der Dunk and Fabio Tronchetti (eds), *Handbook of Space Law* (Edward Elgar, 2015) 29, 87.

¹¹⁹ *UN Charter* art 2(4).

¹²⁰ *GCI* (n 46) art 2; *GII* (n 46) art 2; *GIII* (n 46) art 2; *GCIV* (n 46) art 2.

¹²¹ *OST* (n 1) art VI.

On its face, art VI of the *OST* does establish a very strict regime of responsibility whereby a state is responsible for a non-state entity, such as a company, regarding ‘national activities’ in outer space. This was the very intention of that provision. When it comes to issues of liability and the fraught nature of space travel and activity, it makes perfect policy sense to cast as broad a liability net as possible to ensure that care is taken by all. However, when it comes to employing force contrary to art 2(4) of the *UN Charter* and/or initiating an armed conflict under the terms of common art 2 of the 1949 *Geneva Conventions*, a perverse consequence follows.¹²² The prevailing test under international law in such circumstances to determine if a state has violated these obligations via a non-state entity is that of ‘effective control’.¹²³ Article VI of the *OST* in its clear wording instead suggests attribution at a much lower threshold.¹²⁴ This leaves open the possibility of states being drawn into armed conflict unwittingly by the actions of private companies and other non-state entities.

This is particularly troubling in the context of autonomous systems and AI. As outlined in Part 2 above, it is readily conceivable that such autonomous systems, whose use in the vacuum of space is only going to increase, will inevitably malfunction from time to time. When they do, it is very possible that collisions, physical damage and other tragic consequences will follow. It seems contrary to public policy to conclude that therefore states are violating the prohibition on the use of force and/or initiating armed conflict, even where the state had no prior intention or even knowledge of such illegal activity triggered by an autonomous system and even where such activity was not the result of any intentional human decision. Yet, this is what art VI literally establishes, and it necessarily expands the potential likelihood that states will be drawn into armed conflict because of programming errors, miscalculations and other such unanticipated actions.

However, despite these stark propositions, there is hopefully some room for acknowledging the ‘uncontrolled’ nature of AI-authored decisions of autonomous systems. There is an argument for concluding that if such an action were a ‘mistake’, it would be excluded from the scope of use of force and armed conflict. It has in fact been stated that LOAC does not apply to ‘situations that are the result of a mistake or of individual *ultra vires* acts ... even if they might entail the international responsibility of the State to which the individual who committed the acts belongs’.¹²⁵ This could encompass situations discussed above concerning autonomous systems going ‘haywire’. That said, it is not entirely clear what the requirements for *ultra vires* and mistake actually are in this context. Where does the mistake lie when a state does not build in ‘failsafe’ protocols or otherwise does not anticipate such systems independently ‘deciding’ to cause damage to others in space?

Ultimately, there is no available state practice on how or whether an autonomous action by a space object would be attributed in the space context. A

¹²² *UN Charter* (n 119) art 2(4); *GCI* (n 46) art 2; *GCI* (n 46) art 2; *GCI* (n 46) art 2; *GCIV* (n 46) art 2.

¹²³ *Nicaragua* (n 115) 64–5 [115]; *Draft Articles on State Responsibility* (n 95) art 8.

¹²⁴ *OST* (n 1) art VI.

¹²⁵ Tristan Ferraro and Lindsey Cameron, ‘Article 2: Application of the Convention’ in Knut Dörmann et al (eds), *Commentary on the First Geneva Convention: Convention (I) for the Amelioration of the Condition of the Wounded and Sick in Armed Forces in the Field* (Cambridge University Press, 2016) 68, 87 [241].

rational answer to this question would be that the ‘effective control’ test for attribution would apply consistently with the approach taken by the ICJ in the *Nicaragua* case.¹²⁶ Hence, for a state to be responsible at law for an ‘armed attack’ or for initiating an armed conflict via an autonomous system on a commercial satellite ‘deciding’ to attack another, then orthodox general rules of international law would necessarily apply. A high threshold of direct state involvement and complicity would be necessary. To conclude otherwise defeats the goals of space law, indeed international law more generally, to avoid and prevent armed conflict. However, the converse argument can also be made — that is, if the actions of a commercially-owned space object cause devastating consequences to the space infrastructure of another state, potentially resulting in flow-on impacts to its population, can it be taken for granted that the victim state will simply forgive this, particularly in light of the clear mode of attribution established by the *OST*? Until this matter is settled by state practice, the theoretical possibility of an unfavourable outcome cannot be discounted. Article VI is clear in its literal terms and the risk remains that action of this kind will be attributed to a state.

In launching an autonomous system into space against the strict responsibility background described above, is there also a need to conduct an art 36 review? On the one hand it is hard to conceive of an autonomous system that might be deployed to space to ensure safe docking, or effective repairs or even specialised mining activities as a ‘weapon, means or method of warfare’ thus requiring a weapons review.¹²⁷ On the other hand, given their immense speed, space objects in Earth orbit can easily cause considerable damage in any collision and that may have a devastating impact on space activity as well as activities on Earth. Using a space object to collide with another space object may be characterised as a ‘co-orbital anti-satellite’ weapon, which is itself a counterspace capability under active development by some states.¹²⁸ It is thus reasonable to conclude that any space object is potentially a ‘weapon, means or method of warfare’, especially in the context of autonomous systems with limited human control.¹²⁹ This is compounded by the possibility, discussed above, that the consequences of an autonomous space object causing damage could extend to initiating an international armed conflict. There is some argument that considerations concerning review of any space object as a potential weapon, means or method of warfare should be observed. While the *OST* does prohibit the deployment of weapons of mass destruction in full orbit, as well as their installation on the Moon or stationing in outer space,¹³⁰ it does not prohibit other weapons systems being deployed in space.¹³¹ Given the existing legal regime applicable to space, coupled with the ongoing debate regarding the lawfulness of AWS, it would seem prudent at the very least for states to undertake close assessments of such systems before

¹²⁶ See *Nicaragua* (n 115) 64–5 [115].

¹²⁷ *API* (n 9) art 36.

¹²⁸ Brian Weeden and Victoria Samson (eds), *Global Counterspace Capabilities: An Open Source Assessment* (Report, April 2022) pts 1(01) (United States), 1(02) (Russia), 1(03) (China).

¹²⁹ *API* (n 9) art 36.

¹³⁰ *OST* (n 1) art IV.

¹³¹ *US Law of War Manual* (n 5) 942–3 [14.10.3.1].

launch, even if not formally undertaken in accordance with the obligations under art 36.

V THEMES AND POSSIBLE SOLUTIONS REGARDING AUTONOMOUS SYSTEMS IN SPACE AND WAR

Accountability for international law violations is an ongoing conversation. This is not the case just because of new technological developments, although of course some of the ambiguity stems from the opacity of such systems' functioning to those not directly involved in their development. Rather, it is because of the challenge of seeking international agreement as to how states may be held to account across the board in a number of areas of international law. Humanity has long faltered in its attempts to bring those responsible for serious LOAC violations to account. The 130-year wait for an international criminal court mentioned earlier is not an isolated example: a more recent instance occurred when the Swiss Government and ICRC attempted (between 2011 and 2019) to facilitate a state-led process to improve compliance with LOAC which failed to agree a way forward on mechanisms to bring together states to discuss LOAC violations.¹³²

The international community is certainly grappling with the limitations and uncertainties of existing law when it comes to dealing with autonomous objects in outer space and in LOAC. Indeed, there have long been challenges with the assessment of responsibilities under international law as is evidenced by the process of the *Draft Articles on Responsibility of States for Internationally Wrongful Acts* ('*Draft Articles on State Responsibility*').¹³³ One of these is the question of whether the law applies in the case of omissions, as well as in the case of actions.¹³⁴ This discussion of the various different forms of accountability raises the question of their interaction and thresholds of application. A further question arises in relation to the interaction of civilian and military liability.¹³⁵ In short, the issue seems to be reconciling the LOAC model of individual (or command) criminal responsibility for certain actions — which is itself increasingly challenged by new technologies — with the fundamental space law model of state accountability for all actions undertaken. This is particularly complicated in a modern context where increasingly most actors in space are private actors who act quite independently of the state. Given these issues, the question arises as to whether a different type of accountability discussion is required for addressing issues of systems autonomy in space.

By way of initial observation, three overarching points can be made.

¹³² Helen Durham, 'Strengthening Compliance with IHL: Disappointment and Hope', *Humanitarian Law and Policy* (Blog Post, 14 December 2018) <<https://blogs.icrc.org/law-and-policy/2018/12/14/strengthening-compliance-with-ihl-disappointment-and-hope/>>, archived at <<https://perma.cc/3VMU-VNEM>>.

¹³³ See *Draft Articles on State Responsibility* (n 95).

¹³⁴ See, eg, Gordon A Christenson, 'Attributing Acts of Omission to the State' (1991) 12(2) *Michigan Journal of International Law* 312, 313–4.

¹³⁵ See, eg, Benjamin Kastan, 'Autonomous Weapons Systems: A Coming Legal "Singularity"?' [2013] (1) *University of Illinois Journal of Law, Technology and Policy* 45, 78–81.

The first point is that in both space law and LOAC global discussions around the challenges of accountability are ongoing.¹³⁶ As noted above, at the 2021 United Nations Institute for Disarmament Research the question of future non-binding norms as well as legally binding measures to ensure accountability for activities in space were both firmly on the agenda.¹³⁷ Similarly, at the ongoing GGE LAWS, discussions have often centred around the notion that states shall ensure a human operator or commander exercises actual judgement.¹³⁸ Further, two of the eleven guiding principles developed for the GGE LAWS reference accountability. Guiding principle (b) provides that '[h]uman responsibility for decisions on the use of weapons systems must be retained since accountability cannot be transferred to machines'.¹³⁹ Guiding principle (d) speaks to '[a]ccountability for developing, deploying and using any emerging weapons system' being 'in accordance with applicable international law'.¹⁴⁰ Additionally, and of relevance to both space law and LOAC, discussions about manufacturer liability for the devices continue.¹⁴¹

The second point is that, as Gemmo Fernandez observes '[I]aws cannot be expected to address every concern that may arise from the use of new technology nor can laws predict, with any degree of reliability, the humanitarian concerns that accompany the use or deployment of such technology'.¹⁴² The focus when it comes to LOAC and military operations tends to be on weapons and does not always take into account other means and methods of warfare,¹⁴³ which of course may include activities in space, especially those that employ autonomous systems. Indeed, these problems are made more complex by the nature of outer space, intricacies of the operation of space assets and relative reluctance of states, in a consensus-based system, to negotiate technology-specific and context-based regulations. Indeed, '[t]he law of armed conflict in space needs to be developed in more detail covering the specificities of the outer space environments'.¹⁴⁴

¹³⁶ See, eg, *Reducing Space Threats through Norms, Rules and Principles of Responsible Behaviours: Report of the Secretary-General*, UN GAOR, 76th sess, Preliminary Agenda Item 99(d), UN Doc A/76/77 (13 July 2021); Dimitra Stefoudi et al, 'Report of the 61st Colloquium on the Law of Outer Space' in PJ Blount et al (eds), *Proceedings of the International Institute of Space Law 2018* (Eleven International, 2019) 781, 786–7, 801, 803–4, 809 <https://iislweb.space/wp-content/uploads/2020/02/IISL_Proceedings_2018_Colloquium_Report.pdf>, archived at <<https://perma.cc/VJT3-7242>>.

¹³⁷ '2021 OSS Conference' (n 38).

¹³⁸ See, eg, Group of Governmental Experts on Emerging Technologies in the Area of Lethal Autonomous Weapons Systems, *Outline for a Normative and Operational Framework on Emerging Technologies in the Area of LAWS*, UN Doc CCW/GGE.1/2021/WP.5 (27 September 2021).

¹³⁹ *Guiding Principles*, UN Doc CCW/MSP/2019/9 (n71) annex III para b.

¹⁴⁰ *Ibid* annex III para d.

¹⁴¹ Natalie Nunn, 'Creating Legal Frameworks to Afford Human Accountability for AI Decision in War', in Emma Palmer et al (eds), *Futures of International Criminal Justice* (Routledge, 2022) 210. See also Chengeta (n 98) pt VII.

¹⁴² Gemmo Bautista Fernandez, 'Where No War Has Gone before: Outer Space and the Adequacy of the Current Law of Armed Conflict' (2019) 43(2) *Journal of Space Law* 245, 279.

¹⁴³ Klaudia Klonowska, 'Shifting the Narrative: Not Weapons, but Technologies of Warfare,' *Humanitarian Law and Policy* (Blog Post, 20 January 2022) <<https://blogs.icrc.org/law-and-policy/2022/01/20/weapons-technologies-warfare/>>, archived at <<https://perma.cc/U33R-8R6J>>.

¹⁴⁴ Fernandez (n 142) 279.

Third, some of the concerns are disproportionate. As Tim McFarland points out, some of the ‘accountability gap’ concerns are premised on the idea that an ‘AWS is capable of “making its own decisions”’.¹⁴⁵ No matter how advanced a LAWS is, McFarland argues that an AWS is ‘nothing more than a weapon operating in accordance with human designs’.¹⁴⁶ As such, they are ‘subject to the same accountability regimes’.¹⁴⁷ However, due to the design of international legal responsibility and its complexity, questions remain.¹⁴⁸ This is especially so when an autonomous system is not a ‘weapon’ per se, being designed for an entirely ‘peaceful purpose’, but nonetheless engages in an ‘armed attack’ and prima facie engages states in an armed conflict.

With this in mind, we focus here on three solutions. The first is more robust domestic laws controlling the deployment of autonomous devices, particularly in space. There are advantages to these because ultimately in many jurisdictions they will be needed in any event to incorporate the international law into the domestic framework. However, without the impetus of the pressure created by international legal norms, patchwork domestic laws will certainly not provide a complete solution. The second is to acknowledge the role of ‘military diplomacy’ to establish a practical working framework for construing intention and establishing safe zones for autonomous systems. The third is a new approach, some kind of collective or ‘team’ responsibility that would sit alongside state responsibility or international criminal law.

A Domestic Law is a Valuable Tool

As Helen Quane observes, where there is a gap in existing international law sometimes this means that domestic legal systems will provide the best answer.¹⁴⁹ While not a complete answer here, and indeed caution needs to be exercised in order to avoid a mix of systems that allow corporate actors to ‘forum shop’, in the absence of international agreement (and in concert with it, for dualist states), it is undoubtable that robust national law is important. As Massingham has noted elsewhere, ‘[s]tates have shown that they are willing to use their domestic legal frameworks to regulate the actions of those within their jurisdiction *vis-a-vis* issues of international concern’.¹⁵⁰ Domestic counter-terrorism legislative frameworks¹⁵¹ and actions taken by states in response to the Montreux Document’s

¹⁴⁵ Tim McFarland, *Autonomous Weapons Systems and the Law of Armed Conflict* (Cambridge University Press, 2020) 128.

¹⁴⁶ *Ibid* 129.

¹⁴⁷ *Ibid*.

¹⁴⁸ For a helpful overview of the history of arguments about whether AWS pose an accountability challenge, see Chengeta (n 98) 11–16.

¹⁴⁹ Helen Quane, ‘Silence in International Law’ (2014) 84(1) *British Yearbook of International Law* 240, 269.

¹⁵⁰ Eve Massingham, ‘Entertainment and the Laws of War: The Role of States in their Interactions with the Entertainment Industry in order to Ensure Respect for International Humanitarian Law’ (2021) 24(2) *Media Arts Law Review* 130, 142.

¹⁵¹ See generally Petra Ball and Yvette Zegenhagen, ‘Common Article 1 and Counter-Terrorism Legislation: Challenges and Opportunities in an Increasingly Divided World’ in Eve Massingham and Annabel McConnachie (eds), *Ensuring Respect for International Humanitarian Law* (Routledge, 2020) 178.

recommendations¹⁵² are two successful examples where states have taken these domestic actions in areas of relevance to the LOAC.¹⁵³

In the context of space activities, the responsibility and liability regime imposed upon states by the *OST* does require that states exercise vigilance with respect to launches and other national activities. Despite the lack of specificity in the prevailing treaties, many states have imposed detailed domestic law frameworks to control the utilisation of space.

Australia, for example, imposes strict conditions on commercial actors seeking launching permission.¹⁵⁴ Such conditions include testing and safety evidence relating to the launch vehicle,¹⁵⁵ provision of a comprehensive risk hazard analysis¹⁵⁶ and extensive insurance requirements covering both the company and Australia itself.¹⁵⁷ These specific domestic requirements are imposed consistently with the broad terms of the *OST* so as to provide a greater level of specificity and control over every aspect of space launches for which Australia may be internationally accountable.

The US, unsurprisingly given the scale of space launches conducted there, also places significant legislative requirements on all launching entities.¹⁵⁸ The relevant safety requirements for commercial ventures include, for example, that the launching entity track and record in real time the flight of the object in space,¹⁵⁹ have stress-tested safety-critical systems,¹⁶⁰ ensure the probability of collision is less than 0.00001% throughout all phases of the flight¹⁶¹ and absolutely minimise possible generation of debris by depleting fuel before re-entry, preventing fragmentation and avoiding contact between separated components.¹⁶² The FAA may refuse to issue the license, even if all safety and approval requirements are met, if they determine it would 'jeopardize US national security or foreign policy interests, or international obligations of the United States'.¹⁶³ Commercial ventures must also have minimum levels of insurance and financial responsibility¹⁶⁴ so as to cover the US' obligations under the *Liability Convention*.¹⁶⁵

¹⁵² International Committee of the Red Cross, *The Montreux Document: On Pertinent International Legal Obligations and Good Practices for States related to Operations of Private Military and Security Companies during Armed Conflict* (Report, 17 September 2008) 18.

¹⁵³ See also Massingham (n 150); Eve Massingham, 'Weapons and the Obligation to Ensure Respect for IHL' in Eve Massingham and Annabel McConnachie (eds), *Ensuring Respect for International Humanitarian Law* (Routledge, 2020) 115.

¹⁵⁴ See *Space (Launches and Returns) Act 2018* (Cth) ('*Space (Launches and Returns) Act*').

¹⁵⁵ *Space (Launches and Returns) (General) Rules 2019* (Cth) r 49.

¹⁵⁶ *Ibid* s 52.

¹⁵⁷ *Space (Launches and Returns) Act* (n 154) pt 3 div 7.

¹⁵⁸ *Commercial Space Launch Activities Act*, 51 USC ch 509 (1994); *Streamlined Launched and Reentry License Requirements*, 85 Fed Reg 79566 (2020).

¹⁵⁹ *Streamlined Launched and Reentry License Requirements*, 85 Fed Reg 79566, §450.167 (2020).

¹⁶⁰ *Ibid* §450.143(c).

¹⁶¹ *Ibid* §450.169.

¹⁶² *Ibid* §450.171.

¹⁶³ *Ibid* §450.41(a).

¹⁶⁴ *Commercial Space Launch Activities Act*, 51 USC §50914 (1994).

¹⁶⁵ See *Liability Convention* (n 15).

In accordance with its role as a regulator of space activity, the US FAA has previously intervened in proposed space operations by SpaceX¹⁶⁶ and has caused an ongoing postponement of the company's plans to use a new launch facility in Texas due to delay in an environmental review process.¹⁶⁷

Australia and the US are among a collection of states (including in particular the UK¹⁶⁸ and France)¹⁶⁹ which have now implemented similarly comprehensive domestic legislative frameworks. Such frameworks clearly have the capacity to give states control over what is put into orbit by their nationals and from their territory and ensure, to the greatest extent possible, that the relatively nebulous obligations under the various international space treaties are met. This is one mechanism that states may use to ensure a level of oversight concerning autonomous systems that may become weapons, by requiring that space launch companies include sufficiently specific safeguards regarding such systems (for example, providing override access for a human 'on the loop' monitor, or including a non-AI-mediated navigational failsafe). Ironically, such oversight of objects that are not ostensibly weapons can meet the concerns expressed by some regarding the level of oversight that should be maintained over autonomous weapons systems through separate LOAC obligations.

B *Military Diplomacy has Potential*

There is also room for military-to-military diplomacy to establish an understanding concerning the safe operation of autonomous systems. Such a system could assist states in determining, for example, when a space object is acting in an unorthodox way prior to any potential incident, as well as in setting out protocols for communication between relevant parties. An example of how this could operate is the *Code for Unplanned Encounters at Sea* ('CUES'), negotiated directly between militaries and signed at the 2014 Western Pacific Naval Symposium.¹⁷⁰ CUES was an attempt to standardise safety protocols, communications and manoeuvring which focussed on practical guidelines that could determine in the moment how two vessels should respond to a potential incident. For example, art 2.1 determines actions to be taken to avoid collisions at sea, while art 2.6 sets a minimum safe distance.¹⁷¹ Although voluntary and not

¹⁶⁶ Jonathan O'Callaghan, "Fundamentally Broken": Elon Musk Spars with FAA over SpaceX Starship Launch Approval Delay', *Forbes* (online, 30 January 2021) <<https://www.forbes.com/sites/jonathanocallaghan/2021/01/30/fundamentally-brokenelon-musk-spars-with-faa-over-spacex-starship-launch-approval-delay/?sh=174042d510eb>>, archived at <<https://perma.cc/UAB9-6DCW>>; Vishwam Sankaran, 'Aviation Authority Defends SpaceX in Congress Despite Rocket Launch Ignoring Safety Inspector's Warnings', *Independent* (online, 18 June 2021) <<https://www.independent.co.uk/space/spacex-elon-musk-faa-congress-b1868283.html>>, archived at <<https://perma.cc/9JPT-D8P6>>.

¹⁶⁷ 'SpaceX Starship Super Heavy Project at the Boca Chica Launch Site', *Federal Aviation Administration* (Web Page, 25 March 2022) <https://www.faa.gov/space/stakeholder_engagement/spacex_starship/>, archived at <<https://perma.cc/G44Z-VCZJ>>.

¹⁶⁸ *Space Industry Act 2018* (UK); *Space Industry Regulations 2021* (UK) SI 2021/792.

¹⁶⁹ *Loi n 2008-518 du 3 juin 2008 relative aux opérations spatiales* [Law No 2008-518 of June 2008 relating to Space Operations] (France) JO, 4 June 2008.

¹⁷⁰ Western Pacific Naval Symposium, *Code for Unplanned Encounters at Sea* (22 April 2014) <https://maritimesafetyinnovationlab.org/wp-content/uploads/2016/12/cues_2014.pdf>, archived at <<https://perma.cc/WS4D-F53Q>>.

¹⁷¹ *Ibid* arts 2.1, 2.6.

legally binding, the general agreement of *CUES* has been credited with helping to avoid a serious escalation of tensions in the South China Sea.¹⁷²

Direct liaison between militaries seems more likely to ensure a result, as compared with reliance on the UN Conference on Disarmament (which has been in a ‘prolonged state of paralysis’¹⁷³ for over twenty years due to its universal right of veto). The essential practicality of militaries has produced a tendency to forge a way forward, even in situations of tension — for example, the 1989 agreement between the USSR and the US in relation to the maritime right of innocent passage¹⁷⁴ and, more recently, the 2017 communication agreement negotiated between the US and Chinese navies in the face of ongoing ‘friction’.¹⁷⁵

C *Collective Accountability Options Must be Explored*

Perhaps the problem is that we have been looking too closely to find a particular entity or individual responsible rather than accepting a situation where multiple entities and/or individuals may be jointly responsible.

Although calls for a more collective and collaborative approach have been made in the fields of both LOAC and space law, they have often yielded little by way of results. For example, the original idea behind the requirements in art 36 of *API* for checking compliance with LOAC by new means and methods of warfare was that a Committee of States Party be established to consider the legality of the use of new weapons. However, this proposal did not gain the required two-thirds majority and was not incorporated into the Protocol.¹⁷⁶ Similarly, the more recent efforts of many states, led by the Swiss Government and the ICRC as facilitators, in the form of the Intergovernmental Process on Strengthening Respect for International Humanitarian Law (2015–19), ‘to reach consensus on the establishment of a forum for dialogue among States on IHL’¹⁷⁷ were ultimately unsuccessful.¹⁷⁸

Collaboration is a strong theme in the existing space law framework, particularly the *OST*. The preamble to the *OST* sets out some comparatively vague and aspirational objectives — ‘international co-operation’, ‘mutual

¹⁷² Ankit Panda, ‘Unplanned Encounters in the South China Sea: Under Control?’ *The Diplomat* (online, 25 January 2016) <<https://thediplomat.com/2016/01/unplanned-encounters-in-the-south-china-sea-under-control/>>, archived at ?.

¹⁷³ Paul Meyer, ‘Does the Conference of Disarmament Have a Future?’ (2021) 4(2) *Journal for Peace and Nuclear Disarmament* 287, 287.

¹⁷⁴ *Union of Soviet Socialist Republics–United States: Joint Statement with Attached Uniform Interpretation of Rules of International Law Governing Innocent Passage*, signed 23 September 1989, 28 ILM 1444.

¹⁷⁵ Jim Garamone, ‘U.S., Chinese Military Leaders Sign Agreement to Increase Communication’, *Joint Chiefs of Staff* (Web Page, 15 August 2017) <<https://www.jcs.mil/Media/News/News-Display/Article/1278963/us-chinese-military-leaders-sign-agreement-to-increase-communication/>>, archived at <<https://perma.cc/3XBD-HQTQ>>.

¹⁷⁶ Yves Sandoz, Christophe Swinarski and Bruno Zimmerman (eds), *Commentary on the Additional Protocols of 8 June 1977 to the Geneva Conventions of 12 August 1949* (Martinus Nijhoff Publishers, 1987) 422–3.

¹⁷⁷ ‘Strengthening Compliance with International Humanitarian Law: The Work of the ICRC and the Swiss Government (2015–2019)’, *International Committee of the Red Cross* (Web Page, 23 August 2020) <<https://www.icrc.org/en/document/strengthening-compliance-international-humanitarian-law-work-icrc-and-swiss-government-2015>>, archived at <<https://perma.cc/FG6F-K3D4>>.

¹⁷⁸ Durham (n 132).

understanding’ and ‘strengthening of friendly relations’ — but the treaty also lays down some more practical requirements.¹⁷⁹ The most significant obligations in this regard in the *OST* are art III, which sets out a general obligation on all state parties to conduct activities in space ‘in the interest of maintaining international peace and security and promoting international co-operation and understanding’, and art IX, which provides not only the requirement to give due regard to the interests of other states in undertaking any activities in outer space but also requires consultation with other states in circumstances where such activities may cause ‘harmful interference’. Article VII, as previously discussed, underlines the joint liability of all states who take part in the launching of a space object. Further provisions of the *OST* require collaboration and mutual assistance between States in specific circumstances.¹⁸⁰ Although, as discussed above, states have appeared reluctant to enforce these obligations, nonetheless this remains a potential underpinning for a more comprehensive collective state-mediated governance of space activities.

As a general proposition of international law, the idea of some form of collective or shared responsibility is not new. Indeed, art 42 of the *Draft Articles on State Responsibility* envisages collective interests of a number of states, ‘or the international community as a whole’, being wronged.¹⁸¹

In 2020, a group of expert international lawyers released an interpretive document enunciating Guiding Principles on Shared Responsibility in International Law.¹⁸² Principle 2 provides that

1. The commission by multiple international persons of one or more internationally wrongful acts that contribute to an indivisible injury entails shared responsibility.
2. Contribution to an indivisible injury may be individual, concurrent or cumulative.¹⁸³

An ‘international person’ is defined as a state or international organisation.¹⁸⁴ ‘Injury’ means material and non-material damage (but it does not include legal injury).¹⁸⁵

This is not to say that the adoption of principles of shared responsibility would be seamless. For example, Chengeta cautions against the idea of ‘split responsibility’ among different actors for AWS responsibility questions.¹⁸⁶ He argues it would be a ‘dangerous attempt to conflate different modes of responsibility such as individual, command and corporate responsibility-modes

¹⁷⁹ *OST* (n 1).

¹⁸⁰ See *ibid* art I regarding facilitating international co-operation in scientific investigation, art V regarding rendering assistance to astronauts; informing other states of phenomena endangering astronauts, art X regarding providing opportunities for other states to observe flight of space objects launched, and art XII regarding reciprocal rights of visitation to space installations.

¹⁸¹ *Draft Articles on State Responsibility*, UN Doc A/56/10 (n 95) art 42.

¹⁸² André Nollkaemper et al, ‘Guiding Principles on Shared Responsibility in International Law’ (2020) 31(1) *European Journal of International Law* 15.

¹⁸³ *Ibid* 16.

¹⁸⁴ *Ibid*.

¹⁸⁵ *Ibid*.

¹⁸⁶ Chengeta (n 98) 35.

that stand independently'.¹⁸⁷ This is particularly so in the case of LOAC because of the specific application of LOAC to situations of armed conflict and the fact that those who produce weapons are (ordinarily) not parties to the conflict.¹⁸⁸

Nonetheless, contemporary space operations and the development of autonomous systems (including weapons) are relatively new concepts with unique legal regimes and uncertainties. Rethinking collective responsibility and accountability in this context offers the potential for innovative thinking in realms that have transcended 'old world' concepts.

VI CONCLUSION

The role of autonomous systems across many aspects of military operations, not just weaponry, raises challenging questions surrounding the application of the legal framework. The reality is that the development of existing international law did not contemplate the level of autonomy already evident in modern technology and this does leave some uncertainty going forward, particularly regarding who is responsible when things go wrong. It is in this way that LOAC and the deployment of autonomous weapons and means and methods of warfare overlaps with the current discussion on space law, which has been identified as 'finally' having come to be a 'hot issue' for the law of war community.¹⁸⁹ As the ongoing global discussions on the issue of LAWS demonstrate, and the significant ongoing discussions in space law regarding what are responsible tenets of behaviour illustrate,¹⁹⁰ there are differing approaches and no agreement as to how to deal with the ambiguities. This is not necessarily a case where the law does not have an answer, but it is a case where there is a lack of agreement between states as to what that answer should be.

The unique issues associated with autonomous systems, and especially AWS, are amplified in the context of space where different rules apply, especially in relation to private actors whose actions are directly linked to states. This is a fraught area where the stakes are high and the chances of error equally so. It is therefore timely for states to grapple with these issues directly. While a treaty dealing with autonomous systems in space is unlikely to materialise any time soon, there are other constructive avenues available to states. These include taking the initiative with domestic law, engaging in military-to-military diplomacy to establish basic operating standards and, finally, exploring concepts of collective responsibility to ensure that errors are addressed meaningfully and in a manner that appropriately attributes responsibility. Sophisticated technology, especially autonomous systems, seems to be an inevitable reality of space exploration and armed conflict going forward. Avoiding the legal and physical dangers resident with deploying such systems and taking advantage of their capabilities will be key

¹⁸⁷ Ibid 36.

¹⁸⁸ Ibid.

¹⁸⁹ Laurie Blank, 'Outer Space Finally Makes the Laws of War's Greatest Hits', *Lieber Institute* (Web Page, 30 December 2021) <<https://lieber.westpoint.edu/year-in-review-2021/>>, archived at <<https://perma.cc/82FS-7RWX>>.

¹⁹⁰ Secretary of Defense, 'Tenets of Responsible Behavior in Space' (Memorandum, 7 July 2021) <<https://media.defense.gov/2021/Jul/23/2002809598/-1/-1/0/TENETS-OF-RESPONSIBLE-BEHAVIOR-IN-SPACE.PDF>>, archived at <<https://perma.cc/RYX4-ZGQ9>>.

to ensuring the humanitarian ends of both the regulation of outer space and of armed conflict.