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# Autonomous weapon systems: Is a space warfare manual required?

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## ABSTRACT

### Keywords:

Autonomous weapon systems  
Space law  
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The legalities for the use of Autonomous Weapon Systems (AWS) in space warfare are examined. Currently, there are manuals for air and missile warfare, naval warfare and cyber warfare, a clear gap in the literature is that there is no manual for space warfare. We find that the current jurisprudence of space is somewhat considered analogous to the high seas and in the absence of a Space Warfare Manual, legal jurisdiction may consider that certain treaties are only in effect when in the territory of that State. In turn, the effectiveness of those treaties may mitigate against any obligations related to the military operations of that same State using AWS in space. Whilst it is yet to be tested in the courts, there are significant gaps identified in *Lex lata* and supporting Declarations, Principles and Treaties in terms of space warfare. Such gaps could act as the foundations for both law reform and the requirement for the creation of a Space Warfare Manual.

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In the event that a conflict took place in space, the doctrines and procedures of International Humanitarian Law (IHL) and Customary International Law (CIL) would be relevant in principle. However, in such instances, it would be near impossible to avoid harm to neutral States during warfare. Seeing that space resembles that of the high seas (e.g. arising as a component of the international commons), then such a correlation may allow for the application of naval warfare rubrics. Nonetheless, despite the space and high seas similarities, it may be inappropriate and arduous to apply naval warfare rubrics due to the noteworthy variances in conducting hostilities within the two environments.<sup>1</sup> Consideration has been given to

protective symbols on satellites and space vehicles in an attempt to minimise against attack, similar to land warfare and the protection of cultural objects of special importance. Whilst appealing, timeliness would be an issue, as reaching consensus could be difficult due to the need for ratification of a newly created global convention or annexures to existing conventions. Further complexities arise in relation to the issue of space wherever satellites are in orbit as well as individual States who place strategic importance on space.<sup>2</sup>

Many of the Principles that successfully guide military operations in air, cyber, land and sea may be limited in their applicability to the harsh space environment. Lastly, a

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<sup>1</sup> Crotoft, R. (2015). The Killer Robots Are Here: Legal and Policy Implications, *Cardozo Law Review*, 36, 1837–1915.

<sup>2</sup> Blount, P. J. (2012). Targeting in Outer Space: Legal Aspects of Operational Military Actions in Space, *Harvard Law School National Security Journal*, <http://harvardnsj.org/2012/11/targeting-in-outer-space-legal-aspects-of-operational-military-actions-in-space/>.  
<http://dx.doi.org/10.1016/j.clsr.2017.03.004>

**Table 1 – Definition of space.**

Definition	Source
The dominant view is that space begins at 100 km above the Earth, but some states continue to disclaim the need for the establishment of such a boundary.	Space Security 2010, at 60 (Cesar Jaramillo ed., 2010).
The known and unknown areas of the universe beyond airspace. The boundary between airspace and outer space is not fixed or precise.	Black's Law Dictionary 1212 (9th ed. 2009).
The environment beyond the sensible atmosphere of the Earth.	National Aeronautics and Space Act, 51 U.S.C. § 40302(5) (2010).
The space above the surface of the earth from a height at which it is in practice possible to operate an object in an orbit around the earth.	Space Affairs Act (South Africa, 1993).
Outer space lies beyond the currently undefined upper limit of a state's sovereign airspace. It was declared free for exploration and use by all states and incapable of national appropriation by a 1963 UN General Assembly resolution.	Definition of Space Law, Encyclopaedia Britannica Online: Academic Edition 2011.
In Australia, the Space Activities Act only requires a license for launches of vehicles or payloads that are intended to reach more than 100 km above mean sea level.	Francis Lyall & Paul B. Larsen, <i>Space Law: A Treatise</i> 163 (2009).
Under the functional view, air law should apply to aviation and space law to activities directed towards the use of space. Under such a view, space law would apply to a space launch, which is aborted without reaching orbit, because it is a space activity, and air law would apply to the carriage of a Space Shuttle on the back of a Boeing 747.	Francis Lyall & Paul B. Larsen, <i>Space Law: A Treatise</i> 163 (2009) at 170.
Source: Adapted from Herzfeld, H. (2012). <i>A Guide to Space Law Terms</i> , Space Policy Institute, p. 82.	

discrepancy still exists as to both the definition and boundaries of space (Table 1). It is deemed that 'space' is the area above the earth's atmosphere between the ranges of 145 to 36,000 km above the surface of the earth, where orbiting Satellites operate whilst travelling at speeds of up to 27,000 km per hour.<sup>3</sup>

This paper will be structured as follows; first, a background of AWS in terms of jurisprudence and their impact on global communications, second a definition of space warfare and an overview of both *lex lata* and the rules required for a space warfare manual. Lastly, the call for prohibition of AWS in space and if necessary, the requirement for the creation of a Space Warfare Manual.

## 1. Background

Currently, there is a warfare manual for air and missile warfare (Harvard Guide to Air and Missile Warfare), naval warfare (San Remo Manual) and International Law applicable to cyber warfare (Tallinn Manual), a clear gap in the literature is that there is no manual for space warfare. We provide the proposition for the creation of a Space Warfare Manual and how it could govern in space, the new theatre of war. Currently, there is no Treaty directly dealing with IHL in space. Interestingly, the Outer Space Treaty (signed by 25 and ratified by 103 States),<sup>4</sup> has the potential to be binding on all States due to codification of established CIL.<sup>5</sup>

However, the area of the law dealing with space appears to be inchoate with the Outer Space Treaty (1967) and the Moon

Treaty (1979), as well as various UN General Assembly declarations that attempt to provide regulations to the administration of laws for State liability and the use for AWS in space.

### 1.1. Jurisprudence

Jurisprudence and the lawful deployment of AWS in Space may be the setting where AWS could be deployed for use with minimal risk to the military personnel of a State, civilians or civilian objects. The proviso for this being, that the AWS stays within the parameters of space and does not engage in warfare with earth based targets. AWS is defined by NATO Designation (NATO Industrial Advisory Group SG/75) as: "Autonomous self-learning system – Behavior depends on a set of rules that can be modified for continuously improving goal-directed reactions and behaviors within an overarching set of inviolate rules/behaviors".<sup>6</sup> From a military perspective, there are three levels of autonomy that could be used to classify AWS. First, there are 'human-in-the-loop' systems,<sup>7</sup> which are human-operated<sup>8</sup> and have the capacity to be switched over from manual to automatic and vice-versa.<sup>9</sup> This means the system is human-delegated and operates in automatic mode by default. Second, human-supervised<sup>10</sup> systems operate mostly in autonomous mode and are known as 'human-on-the-loop' systems, where key actions (e.g. a kill order) remain with a human and not the AWS. Third, systems designated 'human-outside-the-loop' allow

<sup>6</sup> Schmitt, N. M. & Thurnher, S. J. (2013). Out of the Loop: Autonomous Weapon Systems and the Law of Armed Conflict. *Harvard National Security Journal*, 231.

<sup>7</sup> United States Department of Defence (USDOD) (2011). Unmanned systems integrated roadmap FY2011-2036, viewed July 2015, <<http://info.publicintelligence.net/DoD-UAS-2011-2036.pdf>>.

<sup>8</sup> European Parliament (EP) (2013). Human rights implications of the usage of drones and unmanned Robots in warfare, Directorate-General for External Policies, European Parliament; viewed July 2015, <<http://www.europarl.europa.eu/committees/en/droi/studiesdownload.html?languageDocument%EN&file%92953>>.

<sup>9</sup> Ibid.

<sup>10</sup> USDOD, above, n. 7.

<sup>3</sup> Space Support to Army Operations (2005). Headquarters – Department of the Army, Field Manual 3-14, United States of America.

<sup>4</sup> Space presence: China, France, India, Iran, Israel, Japan, Russia, South Korea, the United Kingdom, and the United States (Top 10 countries – have either ratified or signed the treaty).

<sup>5</sup> Vereshcetin and Danilenko (1985), which notes that the claims of non-party equatorial States that they are not bound by the treaty's text have been roundly rejected by the majority of States.

for situations where “Machines can select target and deliver force without human command or temporal oversight”.<sup>11</sup> Effectively, this third level of autonomy presents a situation where ‘killer machines’ have the potential to operate with little, if any, human supervision.

The development of weapon systems with such degrees of autonomy means that, at some point, States may see the need to put such ‘killer machines’ against each other. *Lex lata*, the deployment of AWS into space may be lawful because of the necessity to comply with (1) Distinction, (2) Proportionality, (3) Command Input and (4) Judgment, which may be negligible compared to the legal obligations under the existing law for the use of AWS on earth. Considering space as a hostile environment for human beings, and if AWS were to operate in the theatre of space only (e.g. parameters of space – does not engage in warfare with earth based targets and vice-versa), then States will be incentivised to develop the capabilities of AWS specifically for their use in space.

The conduct of hostilities in the theatre of space must be considered through the lenses of a number of basic international legal principles and non-legal elements. First and foremost, the Outer Space Treaty (1969) prohibits the use of space for certain destructive purposes: “States Parties to the Treaty or any other kinds of weapons of mass destruction, install such weapons on celestial bodies, or station such weapons in outer space in any other manner” (art. IV).<sup>12</sup> Space is not subject to the sovereignty of any State as it forms part of the international commons. This gives the right to all States to conduct exploration of space as per principles of the UN Charter and International Law, whilst under a duty to collaborate with all other States when conducting space exploration or scientific investigation.<sup>13</sup> In addition, States are prohibited from the stationing of Weapons of Mass Destruction (WMD), conducting military exercises, stationing of military personnel and the building of military installations and the testing of weapons on celestial bodies.

Importantly, all States have international legal onus for all activities conducted under their jurisdiction, including those of corporate persons, private persons and State agencies.<sup>14</sup> Currently, a State and its parties preserve jurisdiction over their objects launched into space and are burdened with an international onus and liability for damage caused by their space-based objects, including damage to other States and their respective parties.<sup>15</sup> Article 4 of the Space Treaty forbids the ‘testing of any type of weapons’ on ‘the moon and other celestial bodies’ and such bodies are ‘exclusively for peaceful purposes’. These restrictions prevent States from using AWS

for military purposes on the moon or other celestial bodies, however; the voids between them can be used for other military objectives.<sup>16</sup> Whilst space is not currently occupied with AWS, military global-positioning systems, remote-sensing satellites, space-based aspects of an antiballistic missile system and earth-orbit military reconnaissance satellites have occupied space.<sup>17</sup>

## 1.2. Global communications

All States, which in an armed conflict, depend upon communication and navigation satellites, such satellites could be engaged by belligerents even if they are neutral or deemed as non-participant satellites. Regardless, satellites prevented from conducting their functions or destroyed in warfare could have severe consequences for all States from both a military and civil perspective. In terms of space-based AWS, complexities arise when considering other space law treaties (Return of Objects Launched into Outer Space, the Agreement on the Rescue of Astronauts and the Return of Astronauts – Rescue Agreement). Wilful or intended damage caused by either deliberate means or malfunction of the AWS may be liable under the Convention on International Liability for Damage Caused. Furthermore, States may be held accountable to return recovered objects and reimburse related expenses to the State who own and launched the satellite (Art. 5).<sup>18</sup> Satellites are often dual use for both civilian and military purposes (communications, navigation, observation and reconnaissance), being ‘dual use objects’ deems them as military objectives under IHL due to the inherent substantial civil function combined with a military function. Therefore, dependence by all States upon such satellites renders the calculation of collateral harm to civilian activities in relation to military advantage as a higher order compared to that of an attack on non-space dual use objects.<sup>19</sup> However, the cost, vast distances and high speeds of orbiting satellites are significantly different to what the Armed Forces of most States are used to dealing with.

The traditional theatres of war have changed with the scope, are now broader, and include such issues like associated ethics, politics and practices of remote-controlled or autonomous delivery of armed explosives, war as video game, post-heroic age of warfare, the operational delivery of war via semi-autonomous and autonomous devices and warfare with limited risk to States personnel.<sup>20</sup> AWS can use information, independently calculate decisions and materially act upon such decisions. As such, AWS are capable of causing damage on land, at sea and in space independently of their code creator, designer, manufacturer, owner or States. This raises an important legal question as to

<sup>11</sup> Schmitt & Thurnher, above, n. 6.

<sup>12</sup> UN 1967 – United Nations (UN). Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, 610 U.N.T.S. 205. 27 January 1967.

<sup>13</sup> ILA Study Group, The Conduct of Hostilities and International Humanitarian Law Challenges of 21st Century Warfare, Interim Report, <http://www.ila-hq.org/download.cfm/docid/806C2DED-87FF-4744-8CC8EDAF47787AE6>.

<sup>14</sup> Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies 1967.

<sup>15</sup> UN 1967, arts. 6–8.

<sup>16</sup> Cheng, B. (1997). *Studies in International Space Law*, Oxford: Clarendon.

<sup>17</sup> Shackelford, J. S. (2009). From Nuclear War to Net War: Analogizing Cyber Attacks in International Law, *Berkley Journal of International Law*, 27, 192–251.

<sup>18</sup> United Nations (UN). Agreement on the Rescue of Astronauts, the Return of Astronauts and Return of Objects Launched into Outer Space, 672 U.N.T.S. 119. 3 December 1968.

<sup>19</sup> Crootof, R, above n. 1.

<sup>20</sup> Clarke, R. (2014). Understanding the drone epidemic, *Computer Law & Security Review*, 30, 230–246.

**Table 2 – Resemblance of space warfare.**

State	Year	Incident
USA	mid-1980's	The P78-1 communications satellite (functioning in a 555 km orbit) was shot down by an F-15 pilot.
China	2007	Obsolete satellite destroyed by missile.
USA	2008	Malfunctioning satellite USA 193 destroyed.
Source: Sirohi, M. N. (2016). <i>Military Space Force and Modern Defense</i> .		

who is liable for any damage caused. At all times, there must be both protection and respect for the civilian population and objects. Warfare should only be directed at military objectives with the military advantage being real and not theoretical.<sup>21</sup> To date, Space warfare, the new theatre of war, has not transpired. Despite the lack of occurrence, it does not ensure that the future of warfare will not transfer into the unclaimed territory.

## 2. Space warfare

Whilst cyber warfare is not solely conducted in space, the use of satellites to breach and collect information makes it closely related to space warfare. To counteract cyber warfare, the Tallinn Manual was written and put into place. Whilst the placement of a new manual typically comes after warfare has moved into a new arena, waiting to create a Space Warfare Manual could result in serious setbacks. At the current rate of improvement, technology may soon permit warfare to happen out of the atmosphere of Earth. There is a clear lack of experience for all States when it comes to space and with the capabilities of AWS, there is serious risk of venturing into space to conduct warfare.

The closest resemblance of space warfare, involved interactions, between a State and their own satellites whilst occurring during peacetime operations (Table 2). To date, there has been no space warfare between opposing forces nor has there been any human casualties. Moreover, no land based 'target' has ever been neutralised from orbit.<sup>22</sup>

Space already plays an important role in warfare due to the positioning of satellites. Dual-use satellites not only benefit civilians, but also the military of States. Satellites provide technological advantage to States during times of war. Any State that has the technology that gives them the upper hand in warfare could be at a possible risk of having their technology targeted. If any State were to attempt to dominate all arenas of war, interfering with the technology of other States in space could leave them as the dominating force.<sup>23</sup> Space will have

such high strategic value, that in the future, combatants will only conduct warfare in the terrestrial environments once the enemies space based weapons are destroyed and some level of control is exercised over space. Such control could mean that combatant States who lose the space war would rather surrender than potentially be annihilated in both space and terrestrial theatres of war.

AWS will require an assemblage of satellites to assist safe navigation to be positioned advantageously in space over an enemy State. Altitude will play a significant factor in terms of continuous coverage with only eighteen satellites required for coverage at higher altitudes.<sup>24</sup> Pending the type of weaponry attached to a State's AWS, this will set the deployment altitude and allow missiles and projectiles to quickly and easily ascend and descend to a particular altitude to maximize higher velocities due to the absence of an atmosphere; this is where maximum damage can occur.<sup>25</sup> Many believe that AWS alone are the impetus to start wars, especially if a majority of States have no existing space warfare capabilities. Yet the State who can establish control in, or over the space environment could have a clear advantage in terms of either a conventional or a space-based war. As it is within other theatres of war, control is an important prerequisite for basing AWS in space or for winning a terrestrial war. Whilst space may be the most preferred location for AWS, such space-based technology must be balanced against the legal, logistical and practical limitations associated with that environment.<sup>26</sup>

The complete control concept suggests that for States to both protect space based assets and deny combatants the use of strategic areas of space during warfare; arguably, a State must already have weapons (e.g. AWS) terrestrially based. This raises the issue of the type of weapons to be deployed as well as how such weapons are deployed into space.<sup>27</sup> The United States has developed a policy for the autonomy in weapon systems which states that the law of war does not prohibit the use of autonomy in weapon systems.<sup>28</sup> Furthermore, nor does it restrict the use of autonomy to aid in the operation of weapons due to their potential to enhance the way the law of war principles is implemented in military operations. Whilst other rules may apply to weapons with autonomous functions,<sup>29</sup> the argument for the use of AWS continues "they can be a wise choice because they dramatically reduce the danger to U.S. personnel, even eliminating the danger altogether. Yet they are also a wise choice because they dramatically reduce the danger to innocent civilians, especially considered against massive ordnance that can cause

<sup>24</sup> Wilson & van Esch, above, n. 21.

<sup>25</sup> Ulsamer, E. (1981). The Long Leap toward Space Laser Weapons, *Air Force Magazine*, 58–64; Henderson, D. W. (1982). Space-Based Lasers: Ultimate ABM Systems, *Astronautics and Aeronautics*, 44–53.

<sup>26</sup> Tsipis, K. (1981). Laser Weapons, *Scientific American*, 51–57.

<sup>27</sup> Lupton, E. D. (1998). On Space Warfare: A Space Power Doctrine, Airpower Research Institute, Air University Press, Maxwell Air Force Base, Alabama.

<sup>28</sup> Department of Defense (DOD), s 6.5.9, *Law of War Manual*. (2015). Office of General Counsel, United States of America.

<sup>29</sup> International Law. (2010). Digest of United States Practice in International Law, 715, 718–19.

<sup>21</sup> Wilson, H & van Esch, P. (2016). International Humanitarian Law: Attack of the Binary Bullet? *Journal of Politics and Law*, 9(4), 110–113.

<sup>22</sup> Sirohi, M. N. (2016). *Military Space Force and Modern Defence*. Vij Books India Pvt Ltd.

<sup>23</sup> U.S. Army Space and Missile Defense Command (2006). The C2 Puzzle: Space Authority and the Operational Level of War, *The Army Space Journal*.



**Table 3 – Treaties and agreements.**

Treaties and agreements	Year enacted	Purpose
Limited Test Ban Treaty	1963	Prohibits any nuclear weapon test explosion, or any other nuclear explosion in outer space.
Outer Space Treaty	1967	Proscribes placing weapons of mass destruction in space or on the moon or other celestial bodies, and using the moon or other celestial bodies for any military purposes.
Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space	1967	The Rescue Agreement was considered and negotiated by the Legal Subcommittee from 1962 to 1967. Consensus agreement was reached in the General Assembly in 1967 (resolution 2345 (XXII)), and the Agreement entered into force in December 1968. The Agreement, elaborating on elements of articles 5 and 8 of the Outer Space Treaty, provides that States shall take all possible steps to rescue and assist astronauts in distress and promptly return them to the launching State, and that States shall, upon request, provide assistance to launching States in recovering space objects that return to Earth outside the territory of the Launching State.
Anti-Ballistic Missile (ABM) Treaty	1972	Prohibits the development, testing, or deployment of space-based components of an anti-ballistic missile system.
Agreement Governing the Activities of States on the Moon and Other Celestial Bodies	1979	The Moon Agreement was considered and elaborated by the Legal Subcommittee from 1972 to 1979. The Agreement was adopted by the General Assembly in 1979 in resolution 34/68. It was not until June 1984, however, that the fifth country, Austria, ratified the Agreement, allowing it to enter into force in July 1984. The Agreement reaffirms and elaborates on many of the provisions of the Outer Space Treaty as applied to the Moon and other celestial bodies, providing that those bodies should be used exclusively for peaceful purposes, that their environments should not be disrupted, that the United Nations should be informed of the location and purpose of any station established on those bodies. In addition, the Agreement provides that the Moon and its natural resources are the common heritage of mankind and that an international regime should be established to govern the exploitation of such resources when such exploitation is about to become feasible.

Source: Adapted from United Nations (UN). *United Nations Treaties and Principles on Outer Space, related General Assembly resolutions and other documents*. New York: UN, 2008.

*injury and death far beyond its intended target.*” (Speech at the Wilson Center by J. Brennan, Assistant to the President for Homeland Security and Counterterrorism).<sup>30</sup> Whilst AWS in space provides a way to reduce danger to civilians, *lex lata* would require improvements to properly regulate the militant use of AWS.

### 2.1. Lex lata

Strict limits on what military operations can be conducted in space has not been outlined due to the nature of the existing agreements, declarations, principles and treaties. *Lex lata* is outdated due to the liability to keep up with advancements in technology, weaponry and the priorities of States.<sup>31</sup> Considering space warfare was not conceptualized at the time of writing the current legislation, it does not adequately address the changing priorities of States, especially during wartime or *lex ferenda*. Interestingly, in the United States, treaties constitute part of the ‘Supreme Law of the Land’ and those relating to the law of war, have a force equal to that of, laws enacted by Congress (Table 3). Both military and civilian personnel must observe the Principles (Table 4) with strict regard, in terms of

the Constitution and statutes enacted in both the letter and spirit of the law.<sup>32</sup>

Whilst the treaties and agreements provide some regulations for guidance during peacetime, they do not address any modern issues that may occur. For example, the field of space law has evolved to include both property rights and weapons in space. Although many States have enacted treaties, they are not adequately equipped to withstand the advancement of technology, weaponry, or the exploration of space by private companies’. Lastly, space law remains a challenging field to define, due to States having ever-changing national priorities, which may not be echoed in the treaties that were created decades ago.<sup>33</sup>

A set of guidelines are in place for the assessment of the liability of a State for their actions in space (the Convention on International Liability for Damage Caused by Space Objects),<sup>34</sup> as well as requirements for States to keep a register of launched objects (the Convention on Registration of Objects Launched into Outer Space) and to provide firm data to the UN Secretary-General (arts. 2, 4).<sup>35</sup> Moreover, the UN General Assembly has

<sup>32</sup> Ibid.

<sup>33</sup> US Marine Corps, (1976). FM27-10, MCRP 5-12.1A, The Law of Land warfare, PCN14400004400.

<sup>34</sup> United Nations (UN). Convention on International Liability for Damage Caused by Space Objects, 961 U.N.T.S. 187. 29 March 1972.

<sup>35</sup> United Nations (UN). Convention on Registration of Objects Launched Into Outer Space, 1023 U.N.T.S. 15. 15 September 1976.

<sup>30</sup> The Ethics and Efficacy of the President’s Counter-terrorism Strategy. (2012). *Digest of United States Practice in International Law*, 584, 586.

<sup>31</sup> US Marine Corps, (1976). FM27-10, MCRP 5-12.1A, The Law of Land warfare, PCN14400004400.

**Table 4 – Principles supporting the treaties.**

Principles supporting the treaties	Year enacted	Purpose
The Declaration of Legal Principles	1963	The Declaration led to the development of the Outer Space Treaty (created in 1967), which lays down guiding principles, including the idea that space exploration is for the benefit of all human mankind.
The Broadcasting Principles	1982	Has to do with television broadcast signals. These principles include the idea of non-interference with other countries States' signals, the provision of information to help with knowledge exchange, and the promotion of educational and social development (particularly in developing nations).
The Remote Sensing Principles	1986	Allows the use of electromagnetic waves to collect data on Earth's natural resources. Remote-sensing activities are supposed to be for all countries States' benefit and should be carried out in the spirit of international cooperation.
The Nuclear Power Sources Principles	1992	Concerns how to protect humans and other species from radiation if a launch goes awry, or a spacecraft flying by Earth accidentally crashes to the surface. It's common for spacecraft exploring the outer solar system to use nuclear power sources for energy, since solar power is so weak out there becomes redundant.
The Benefits Declaration	1996	States that space exploration shall be carried out for the benefit of all States. This was created two years before the International Space Station – an effort of 15 nations – launched its first two modules into space.
Source: Adapted from United Nations (UN). <i>United Nations Treaties and Principles on Outer Space, related General Assembly resolutions and other documents</i> . New York: UN, 2008.		

also espoused particular declarations of legal principles and resolutions in terms of the actions of a State in space.<sup>36</sup> In support of AWS, two declarations may have particular relevance: (1) The Principles Relevant to the Use of Nuclear Power Sources in Outer Space and (2) The Principles Relating to Remote Sensing of the Earth from Outer Space. The former's applicability is potentially because AWS may have the potential to be nuclear powered<sup>37</sup> and the latter arguably has CIL status,<sup>38</sup> and may offer regulation on weapon systems gathering and processing information whilst based in space and how to mitigate against their controversy.<sup>39</sup> Limitations on the deployment of AWS should be considered, including tele-operated AWS systems, because there is an extensive consensus across the literature that AWS as well as other advanced technological weapons have already been utilised in a way which contest the interpretations of IHL and s.2(4) of the UN Charter governing the resort to force.<sup>40</sup> Interestingly, there appears to be no support within the literature in terms of 'no special controls' over AWS. Strawser (2010)<sup>41</sup> calls for a moral and ethical

duty to use AWS in warfare only after *jus ad bellum* has been achieved. However, he further limits this claim to the use of Unmanned Aerial Vehicles (UAVs) only.

In order to create an effective Space Warfare Manual, a Committee of Governmental Experts would need to both identify and redress the gaps in *Lex lata*. The Agreements, Principles, Treaties and existing International Law could be used as a guide to structure the Space Warfare Manual. However, there is a clear need to incorporate technological advancement in weapon systems and how they might be used when conducting hostilities.<sup>42</sup> *Lex lata* does not adequately protect the jurisprudence of a State if space warfare was initiated. Currently, there are no direct treaty provisions that deal with 'space warfare'. This is because States' space weapon development and *opinio juris* are scarce, therefore; it is difficult to conclusively determine that any space warfare CIL norms exist. Interestingly, the Committee of Governmental Experts will need to decide if both *jus ad bellum* and *jus in bello* apply to space warfare and to seek consensus when identifying the applicable *lex lata*, governing space.

## 2.2. Rules for the space warfare manual

The rules in the Space Warfare Manual would need to set forth *lex ferenda*, best practice, or preferred policy. Where possible, the rules would need to accurately articulate the intent of CIL and IHL, which would become binding on all States, the exception being of those States that become constant objectors. In such cases, States that would use the Space Warfare Manual, would be cautioned that they may be subject to additional norms set forth in treaties to which they are Party. Customary law of war is binding upon all nations and is strictly observed by the United States. Exceptions are recognized when legitimate reprisals are required due to illegal conduct of

<sup>36</sup> United Nations (UN). *United Nations Treaties and Principles on Outer Space: Text of Treaties and Principles Governing the Activities of States in the Exploration and Use of Outer Space*. Geneva: UN, 2002.

<sup>37</sup> Ibid, 42–8.

<sup>38</sup> Lyall, F & Larsen, B. P. (2009). *Space Law: A Treatise*. (eds). Farnham, England and Burlington, VT: Ashgate.

<sup>39</sup> United Nations (UN), above, n. 18, 38–41.

<sup>40</sup> Lin, P. (2010). Ethical blowback from emerging technologies. *Journal of Military Ethics*, 9(4), 313–331; Marchant, G. E. (2011). International governance of autonomous military robots. *The Columbia Science and Technology Law Review*, 12, 272–315; Sauer, F & Schörnig, N. (2012). Killer Drones – The Silver Bullet of Democratic Warfare? *Security Dialogue*, (43)4, 363–380; Sharkey, N. (2010). Saying 'no!' to lethal autonomous targeting. *Journal of Military Ethics*, 9(4), 369–383; Sparrow, R. W. (2007). Killer Robots. *Journal of Applied Philosophy*, (24)1.

<sup>41</sup> Strawser, B. J. (2010). Moral predators: The duty to employ uninhabited aerial vehicles, *Journal of Military Ethics*, 9(4), 342–368.

<sup>42</sup> Schmitt, M. N. (2013). *Tallinn manual on the international law applicable to cyber warfare*. Cambridge University Press.

combatant States. The United States views the customary law of war as having no inconsistencies with any treaty, controlling executive or legislative act to which the country is Party and therefore, is further binding on all US citizens and persons serving the country. As such, it can be argued that *Lex lata* may not be well equipped enough to deal with warfare in space.<sup>43</sup>

### 3. Space warfare manual

Civilian safety must be the primary objective if the opportunity exists for large-scale deployment of AWS in space.<sup>44</sup> Moreover, it is about “the clash of legal systems under the impact of cyber space and the emergence of new challenges to national legal systems not familiar with a borderless environment”.<sup>45</sup> However, there are concepts that would need to be addressed, such as how broad the merits of AWS are, as well as, if space-based AWS would allow new strategy to militarize space. Therefore, as technology becomes more widespread and warfare in space becomes increasingly possible, it may not be practical to apply traditional legal doctrines such as CIL, IHL, product liability or negligence (e.g. tort) when attempting to apportion liability.

In Space, the lack of an atmosphere, vast distances and environmental characteristics that include aerodynamic drag and lift and blast (e.g. weapon effects) all influence how warfare would be conducted.<sup>46</sup> If nuclear weapons were attached to autonomous weapon systems, the potential for long-range electromagnetic weapon effects is greater. Whilst there is no blast effect in the space void, any radiation created by a nuclear weapon could travel freely due to the absence of atmospheric attenuation. In the Space environment, this extrapolates into radiation being the principal kill instrument rather than the explosion itself. Thus, the destruction extent is magnified compared to what would occur in the atmosphere.<sup>47</sup> Furthermore, if directed energy weapons become operationally feasible, the killing capacity is over vast ranges and at the speed of light, giving more capability than their atmospheric use.<sup>48</sup>

Speeds not attainable in the atmosphere occur in space due to the absence of atmospheric drag. Therefore, such speeds allow small masses to have enormous kill capacity due to the enhancement of kinetic energies. Moreover, any ammunition that deorbit may destroy both airborne and surface targets

because their velocity is retained.<sup>49</sup> A further environmental challenge is that space presents new frontiers where space warfare could occur in an infinite arena. States can exploit these new frontiers, for military purposes, provided they have adequate technology, systems and transportation to get to and operate in space. Arguably, the more technologically advanced a State is, the more power and control they will have in the space environment.

It is paramount that space remains a safe-haven.<sup>50</sup> Because of the vast distances and expense to reach space, it could mean that warfare could be won or lost on the capture and long-term detention of hostages, given the State with the most resources has the ability to hold out the longest. The challenge for combatants in space will be to ensure that the ability to take and hold hostages does not become too unequal.<sup>51</sup> However, if the theatre of space warfare is conducted via AWS only, the impact on military personnel could be negligible. Military strategists believe that by co-joining nuclear with AWS, wars will be won or lost by who wins the space battle, especially in relation to any future global nuclear wars. Again, either financial resources or technological capability will ensure a State possesses such weapons, which results in a favourable tilt in the balance of power. Considering unfavourable balances in power and potential destruction of a combatant State by nuclear AWS in ground warfare, is it best that such wars are only held in remote, uninhabited environments such as space?<sup>52</sup> History holds that for every new offensive weapon created, so too is a defensive counter-measure. In relation to space the offensive-weapon vs defensive-counter-measure argument becomes opaque due to the following criteria: affordability, believability and feasibility.<sup>53</sup>

With the outdated agreements and conventions that have been made concerning space, moving for the creation of a Space Warfare Manual could guarantee some type of control if warfare were to occur in space. Even before the creation of a Space Warfare Manual, States should collectively push to eliminate AWS in any theatre of warfare. In 2015, signatories including Professor Stephen Hawking, Steve Wozniak (Apple) and Elon Musk (Tesla, SpaceX) called for the prohibition of AWS. In turn, the International Committee for Robot Arms Control (ICRAC) extended this call, specifically seeking to limit the deployment of AWS in space. The intent of prohibition is to cover both semi-autonomous and fully autonomous weapons, not just in space but also in any theatre of operation. Paradoxically, tolerance is given for tele-operated systems, albeit that they are not used in space. Yet in warfare, submissions of ethics almost

<sup>43</sup> Holder, C., Khurana, V., Harrison, F & Jacobs, L. (2016). Robotics and law: Key legal and regulatory implications of the robotics age (Part I of II), *Computer Law & Security Review*, 32, 383–402.

<sup>44</sup> Finn, L. R & Wright, D. (2012). Unmanned aircraft systems: Surveillance, ethics and privacy in civil applications, *Computer Law & Security Review*, 28, 184–194.

<sup>45</sup> Coteanu, C. (2005). Cyber Consumer Law and Unfair Trading Practices, Ashgate Publishing Limited; Saxby, S. (2007), Book Reviews: Cyber law, *Computer Law & Security Report*, 23, 86–87.

<sup>46</sup> Hanifen, W. D & Kuller, G. W. (1981). Fragility of Space Operations in a Nuclear War, *Air University Airpower Symposium*, Kirtland AFB, N. Mex.: Air Force Weapons Laboratory, 2–28.

<sup>47</sup> Ibid.

<sup>48</sup> Ulsamer, E. (1981). The Long Leap Toward Space Laser Weapons, *Air Force Magazine*, 58–64; Henderson, D. W. (1982). Space-Based Lasers: Ultimate ABM Systems, *Astronautics and Aeronautics*, 44–53.

<sup>49</sup> Krafft A. E. (1960). *Space Flight*, Vol. 1, Environment and Celestial Mechanics, ed. Crayson Merrill (New York: D. Van Nostrand Co., Inc.), 287.

<sup>50</sup> Trezza, C. (1982). A New Dimension of Arms Control: Avoiding an Arms Race in Outer Space, *Dialogue*, 46–51; Bethe, A. H & Gottfried, K. (1983). Save Us All, Congress: No Weapons in Space, No Unratified Treaties, *Washington Post*, 6 February 1983, B1.

<sup>51</sup> Giffen, B. R. (1982). US Space System Survivability: Strategic Alternatives for the 1990s, National Security Affairs Monograph Series 82-4, Washington, D.C.: National Defense University Press, 33–34, 49–52.

<sup>52</sup> Watts and Lord, 991.

<sup>53</sup> Ulsamer, E. (1981). The Long Leap Toward Space Laser Weapons, *Air Force Magazine*, 58–64.

always arise. Consequently, strong opposition to the placement of AWS in space has extended the petition of existing bans of Weapons of Mass Destruction either in orbit, on the moon or other celestial bodies. Combined (e.g. AWS armed with WMD), this presents an exceptionally strong contention. The application of law concerning AWS in space is embryonic, during such a time, a ban on such weapon systems under the precautionary principle may be necessary. Such opacity may require limitations be imposed on the capability, number and size of AWS (including dual-purpose autonomous satellites) in space. Failing to do so may have catastrophic consequences in terms of human collateral damage should conflicts involving AWS occur.

Such an example can be seen in dual-purpose satellites (e.g. civilian and military use), where the use of Global Positioning Systems (GPS) create an area of uncertainty. Therefore, semi-autonomous or fully autonomous dual-purpose satellites raise the issue of whether such functionality and technology should be completely banned in terms of AWS. However, if warfare in the future means a vital military objective of a State is to control the high ground of space, then any such State with advanced capabilities in AWS (e.g. United States and United Kingdom) would not be likely to sign-up to any such prohibitions.

Even if warfare was to not take place outside the earth's atmosphere, there is potential for AWS to be used as high-ground space-based weapons. This technological advantage may be the catalyst for moving wars into that remote, largely uninhabited environment known as space.<sup>54</sup> If the movement to prohibit AWS does not become a regulation that States sign onto, the creation of a Space Warfare Manual is the next step. Unlike waiting for warfare to move to space before creating a

Space Warfare Manual, the proactive preparation of such a manual could be the difference in protecting all States assets, civilians and set the standard on how space is to be controlled. Because there has not been any type of warfare in space, a Space Warfare Manual that is written would set rules based on the speculation of the capabilities of technology and its use in space.

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#### 4. Conclusion

In the absence of a Space Warfare Manual, the legalities of space are somewhat considered analogous to the high seas “*This is an attempt, once we leave airspace, and get to outer space, however you define the limits, this is an attempt to create in outer space the closest analogy and that is the high seas.*”<sup>55</sup> In addition, it appears that ‘other’ treaties may inhibit military operation in space (e.g. Treaty Banning Nuclear Testing in the Atmosphere, Oceans, and Outer Space). Legal jurisdiction may consider that certain treaties are only in effect when in the territory of a State, which in turn may mitigate against any obligations related to the military operations in space of that same State. It is most likely that States would rely on both customary law of war and the law of war treaties to legalise warfare in space as such application would be deemed appropriate because it is used in the air, cyber, land and sea domains. Whilst it is yet to be tested in the courts, there are identified significant gaps in *Lex Lata*, Declarations, Principles and Treaties that could act as the foundations for both law reform and the requirement for the creation of a Space Warfare Manual.

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<sup>54</sup> Graham, D. (1982). *High Frontier: A New National Strategy*, Washington, D.C.: High Frontier, 21–25.

<sup>55</sup> Arthur J. Goldberg, U.S. Ambassador to the United Nations, Treaty on Outer Space: Hearings before the Committee on Foreign Relations, U.S. Senate, 90th Congress, First Session, 63 (Mar. 13, 1967).