Dual-Use Phenomenon: The Humanitarian Law Implication for Less Technologically Advanced States During Armed Conflict in Space, A Case Study of Ukraine-Russia War

by

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January 2024

A thesis submitted to McGill University in partial fulfilment of the requirements of the degree of Master of Laws (LLM).

TABLE OF CONTENTS

ABSTRACT

This thesis comprehensively scrutinizes dual-use nature of satellites in the Ukraine-Russia conflict, evaluating its impact on Ukraine as both an aggression victim and a Less Technologically Advanced Country (LTAC). My primary research question is: How do dual-use satellites impact International Humanitarian Law and the Laws of Armed Conflict, particularly for LTACs in the context of space warfare? Chapter 1 primarily evaluates the implications of dual-use satellites on International Humanitarian Law (IHL) and the Laws of Armed Conflict (LOAC). Chapter 2 examines the contrast between space weaponization and militarization, highlighting current arms control regimes. It identifies significant gaps that may allow for potential hostile use. Chapter 3 underscores the imperative for a nuanced application of IHL principles in the context of space warfare. Chapter 4 emphasizes the intricate role of dual-use space assets, particularly in the ongoing Russia-Ukraine conflict. Chapter 5 critically assesses the efficacy of IHL in safeguarding LTACs, highlighting challenges posed by the dual nature of space technologies and the absence of space-specific international legal frameworks. The conclusions reached are that there is a shared understanding regarding the need for a refined and comprehensive approach aligning legal norms with technological advancements and geopolitical considerations in the domain of space warfare and IHL. In this concluding Chapter 6, I delineate the impact of identified challenges on the legitimacy of the space regime, proposing pragmatic solutions to bolster the legitimacy of dual-use assets in space warfare. I advocate for a legal framework addressing the complexities of dual-use satellites in space warfare, ensuring equitable protection for less technologically advanced countries.

RESUME

Cette thèse examine de manière approfondie la nature à double usage des satellites dans le conflit Ukraine-Russie, évaluant son impact sur l'Ukraine à la fois en tant que victime d'agression et pays moins avancé technologiquement (LTAC). Ma principale question de recherche est la suivante : quel est l'impact des satellites à double usage sur le droit international humanitaire et le droit des conflits armés, en particulier pour les LTAC dans le contexte de la guerre spatiale ? Le chapitre 1 évalue principalement les implications des satellites à double usage sur le droit international humanitaire (DIH) et le droit des conflits armés (LOAC). Le chapitre 2 examine le contraste entre l'armement spatial et la militarisation, en mettant en lumière les régimes actuels de contrôle des armements. Il identifie des lacunes importantes susceptibles de permettre une utilisation hostile potentielle. Le chapitre 3 souligne l'impératif d'une application nuancée des principes du DIH dans le contexte de la guerre spatiale. Le chapitre 4 met l'accent sur le rôle complexe des ressources spatiales à double usage, en particulier dans le conflit en cours entre la Russie et l'Ukraine. Le chapitre 5 évalue de manière critique l'efficacité du DIH dans la protection des LTAC, en soulignant les défis posés par la double nature des technologies spatiales et l'absence de cadres juridiques internationaux spécifiques à l'espace. Les conclusions tirées sont qu'il existe une compréhension partagée de la nécessité d'une approche raffinée et globale alignant les normes juridiques sur les progrès technologiques et les considérations géopolitiques dans le domaine de la guerre spatiale et du DIH. Dans ce chapitre 6 de conclusion, je délimite l'impact des défis identifiés sur la légitimité du régime spatial, en proposant des solutions pragmatiques pour renforcer la légitimité des actifs à double usage dans la guerre spatiale. Je plaide en faveur d'un cadre juridique abordant les complexités des satellites à double usage dans la guerre spatiale, garantissant une protection équitable aux pays les moins avancés technologiquement.

ACKNOWLEDGEMENTS

From my earliest days, a fascination with space has been a constant in my life, leading me to delve into the intricate field of space law. I express my heartfelt gratitude to Qatar, my home country, for fostering an environment that encourages curiosity and learning, laying the foundation for my academic journey.

To my family, your unwavering support during my time in Montreal has been the cornerstone of my academic pursuit. Mom, Dad, and siblings, your encouragement has transformed my childhood curiosity into a dedicated exploration, and for that, I am truly thankful.

A special acknowledgment goes to my supervisor, Professor René Provost, for his invaluable assistance in guiding me from the inception of the thesis idea to its conclusion. His mentorship, expertise, and insightful feedback have been crucial in shaping the research and ensuring the successful completion of this academic endeavor.

To the Air and Space Institute at McGill University, thank you for providing an environment conducive to intellectual growth and exploration. This graduation marks not just an academic achievement but the beginning of a future shaped by the profound knowledge acquired here.

CHAPTER I – INTRODUCTION

This thesis aims to examine the dual-use character of satellites which are capable of serving both military and civilian purposes. It interrogates the applicability and effectiveness of existing IHL principles, for instance, precautions, proportionality, and distinction in the realm of space warfare. The thesis contends that these IHL principles insufficiently protect Less Technologically Advanced Countries (LTACs) from the potential dangers of space warfare. This is attributable to their origin set in a different legal and historical background when space warfare was not seen as a tangible reality. The thesis also dissects Russia's position on the military utilization of the Starlink satellites by Ukraine which it sees as a threat to its national security. Additionally, the thesis provides a concise overview of the repercussions of the Russia-Ukraine war on IHL and space warfare highlighting issues such as intensification of conflict, collateral harm, and environmental damage. It scrutinizes the peculiar characteristics of space and space law including principles such as peaceful use, cooperation, and non-appropriation. It also provides a snapshot of IHL highlighting elements like sources, scope, and applicability of its rules. This thesis assesses the unique challenges of applying IHL in space warfare, including issues in identifying parties and targets, while exploring the potential role of international organizations and treaties in promoting state cooperation and compliance with IHL principles in outer space. Ultimately, it appraises the unique application of IHL in space warfare such as challenges in identifying parties, targets, and aftermath of attacks. This thesis contributes to the debate on IHL effectiveness in supervising space activities and safeguarding less technologically advanced countries, emphasizing the need for precise rules in the face of challenges in applying IHL to space warfare. This research aims to offer insights for policymakers and legal experts seeking a more comprehensive framework for regulating space activities, outlining specific improvements to the existing policy framework.

1.1 Overview of the Dual Use Phenomenon

The principle of dual-use assets is not confined to the domain of space. It permeates various other sectors, including but not limited to telecommunications, aviation, and nuclear energy.[1] According to Jakub Pražák, dual-use assets in space refer to space systems, technologies, or components that have both civilian and military applications[2] including their anti-satellite (ASAT) capabilities.[3] Space technology is no longer monopolized by a few technologically advanced nations and has become more accessible, cheaper, and far more capable.[4] With the increasing prominence of satellites and space technologies in the realm of global operations and military activities, governments are transitioning from being providers of space services to being purchasers.[5] Against this backdrop, it is pertinent to note that dual-use space assets can have a positive and negative impact on LTACs in a variety of ways.[6] On the plus side, dual-use space assets can provide numerous benefits to developing countries, such as improved communication and navigation systems, weather monitoring and prediction, and remote sensing capabilities for natural resource management and disaster response.[7] These technologies can also help to stimulate economic development by spawning new industries and job opportunities. On the other hand, they also have the potential to further heighten existing

[1] Jordi Molas-Gallart, "Which way to go? Defence technology and the diversity of 'dual-use' technology transfer" (1997) 26:3 Res. Pol. 367–385 at 372.

[2] Jakub Pražák, "Dual-use conundrum: Towards the weaponization of outer space?" (2021) 187 Acta Astronautica 397–405 at 397.

[3] "The Future of Space is Powered by Dual Use Technology", (10 March 2023) at para 4, online: *NSTXL* <https://nstxl.org/the-future-of-space-is-powered-by-dual-use-technology/>.

[4] *Ibid* at para 2.

[5] *Ibid* at para 5.

[6] In this thesis, LTACs are those countries that have very little footprint in space and must rely on spacefaring nations and/or commercial providers of space assets. Ukraine is among the LTACs.

[7] Roxanne Pope, "Space Weapons and the Increasing Militarisation of Outer Space: Whether the Legal Framework Is Fit-for-Purpose" (2021) 27:1 Auck UL Rev. 263 at 281.

geopolitical tensions and inequalities.[8] Examples of dual-use assets in space include, communication satellites that are essential for global connectivity and commercial applications such as broadcasting, internet access, and telephony but can also be used for military purposes such as command and control, intelligence gathering, and jamming.[9]

Therefore, the concept of dual-function assets in space underscores the major issues relating to security, proliferation and international law.[10] The proficiency of a nation's military forces can be substantially increased thus posing a risk to military balances and international security.[11] Furthermore, the implementation of dual-use assets in space can lead to the militarization of space and infringe upon all the peaceful uses of outer space, which is the basic principle advocated by international space law.[12] For this reason, the concern about the potential conflicts in space is growing, resulting in the need to safeguard space assets during periods of conflicts.

1.2 Dual Use Phenomenon in Modern Conflicts

In the backdrop of the Russia-Ukraine conflict, dominance over space has emerged as a significant point of contention. Based on reports on the Russia-Ukraine war, space assets are being extensively used, however, the nature and degree of usage remain unknown due to security reasons.[13] Additionally, commercial space competencies have played a prominent role in warfare[14], making this the first substantial conflict where both parties to the war have

[8] *Ibid* at 271.

[9] Holger Lueschow & Roberto Pelaez, "Satellite Communication for Security and defense" in Kai-Uwe Schrogl, *Handbook of Space Security - Policies, Applications and Programs*, 2nd ed. (Springer, 2020) at 782.

[10] Pope, *supra* note 7 at 282.

[11] NSTXL, *supra* note 3 at para 6.

[12] Pražák, "Dual-use conundrum", *supra* note 2 at 398.

[13] Dylan Huw & Thomas J. Maguire, "Secret Intelligence and Public Diplomacy in the Ukraine War" (2022) 64:4 Survival 33–74 at 61.

[14] Jonathan Beale, "Space, the unseen frontier in the war in Ukraine", (5 October 2022) at para 1, online: *BBC News* <https://www.bbc.com/news/technology-63109532>.

displayed strong reliance on space.[15] The primary concern at hand is a lack of clear guidelines on IHL principles that would apply to Ukraine, a country lacking in space capability but in desperate need of it for national security and survival.[16] The crisis in Ukraine demonstrates the need for disciplinary responses to the conflict over the meaning of international legal order's foundational building blocks. It reveals the challenges of applying IHL principles such as military necessity, humanity, distinction, precaution, and proportionality and demands a nuanced understanding of the interplay between legal frameworks, technological advancements, and geopolitical realities.

1.3 Space Law: Addressing the Distinctive Nature of Space

Space law is a part of public international law and refers to a body of rules and regulations that govern human activities in outer space. It aims to regulate activities and ensure peaceful and cooperative use of space. The development of rocket technology during World War II and the subsequent flights of man-made objects into outer space highlighted the need for legal principles to address the unique issues raised by space activities. The Treaty Banning Nuclear Weapons Tests in the Atmosphere, in Outer Space and Under Water, also known as the Partial Test Ban Treaty, was the first legally binding international agreements to limit activities in space.[17] Outer space is considered a common heritage of mankind, and there are provisions in space law that prohibit the establishment of military bases, testing of weapons, and conducting military manoeuvres on celestial bodies.[18] The pathway was paved for the establishment of a

[15] *Ibid* at para 1.

[16] Molas-Gallart, *supra* note 1 at 169.

[17] Todd Harrison, "International Perspectives on Space Weapons" (May 2020) at 9, online (pdf): *Center for Strategic & International Studies* <https://aerospace.csis.org/wpcontent/uploads/2020/05/Harrison_IntlPerspectivesSpaceWeapons-compressed.pdf>.

[18] 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 Int. Law. Stud. 75 at 75.

more comprehensive agreement on the principles that would guide the activities of nations in their exploration and peaceful utilization of outer space. This was achieved through the General Assembly's landmark Resolution 1962 (XVIII) of 13 December 1963. This significant resolution subsequently facilitated the negotiation and signing of the Outer Space Treaty in London, Moscow, and New York in January 1967.[19] It signifies the creation of an entirely new branch of public international law, the law of outer space.

Considering this, it is pertinent to give deliberation to the definitional issues in space law. The different terminology used, such as "space objects," "celestial bodies," and "near earth objects," raises concerns about the applicability of international space law.[20] However, the most significant definitional issue is the lack of a clear definition of what constitutes a "peaceful purpose" in space.[21]

1.4 Milestones in the Genesis of Space Law

Understanding the legal and historical context of international space law is crucial for analysing the dual-use phenomenon's implications on LTACs, as early space endeavours' legal fundamentals guide contemporary discourse and inform frameworks addressing dual-use technologies in armed conflict in space. The cardinal events that precipitated the genesis of space law include the Launch of Sputnik in 1957 and Explorer in 1958 which exhibited the possibilities of space and stressed the necessity of legal frameworks.[22] The USSR's Sputnik

[19] Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, 27 January 1967 18 U.S.T. 2410 610 U.N.T.S. 205, 61 I.L.M. 386 (entered into force 10 October 1967).

[20] Frans von der Drunk, "Defining Subject Matter under Space Law: Near Earth Objects versus Space Objects" (2008) 25 Space, Cyber, and Telecommunications Law Program Faculty Publications 293–303 at 294.

[21] Sa'id Mosteshar, "Space Law and Weapons in Space" (2017) Ox. Res. Ency. Planet. Sci. 74 at 81.

[22] Cheryl L. Marlin, "Space race propaganda: US coverage of the soviet Sputniks in 1957" (1987) 64(2-3) Journalism Quarterly 544 at 547.

launch showcased technological prowess and triggered discussions on jurisdiction, sovereignty, and control, echoed by the United States' Explorer launch.

In response to these events, the United States implemented its national space law and backed the development of international space law culminating in the Outer Space Treaty and the 1958 National Aeronautics and Space Act.[23] A crucial step in shaping space law, the National Aeronautics and Space Act laid the foundation for peaceful exploration and use of outer space, establishing NASA to oversee U.S. space activities. The advent of space law was profoundly associated with the aftermath of the Cold War, with both the United States and the USSR working together in UNCOPUOS to introduce a legal structure in outer space for peaceful purposes.[24] This joint effort represented a shift from competition to cooperation in the realm of space exploration. The UNCOPUOS played an instrumental role in fostering dialogue between these two superpowers which led to a consensus on fundamental principles such as freedom of exploration, non-appropriation of space by any one nation and the use of space exclusively for peaceful purposes. The negotiations between the Soviet Union and the USSR during the Cold War period formed the basis of the current legal framework.[25] These negotiations were distinguished by a fine balance of power and common interests.

[23] Tanja Masson-Zwaan & Roberto Cassar, "The Peaceful Uses of Outer Space" in Simon Chesterman, David M. Malone, Santiago Villalpando, *The Oxford Handbook of United Nations Treaties,* 1st ed. (online edition: Oxford Academic, 2019) at 183.

[24] Stefania Paladini, "The Legal Dimensions of Space" in Stefania Paladini, *The New Frontiers of Space: Economic Implications, Security Issues and Evolving Scenarios,* 1st ed. (Cham: Springer International Publishing, 2019) at 187.

[25] Biswanath Gupta & Ekta Rathore, "United Nations General Assembly Resolutions in the Formation of the Outer Space Treaty of 1967" (2019) 17:2 Astropolitics 77–88 at 79.

1.5 The Partial Test Ban Treaty

In the mid-1950s regulators and policymakers in the Soviet Union, the United States, France and the United Kingdom were wary of the perils of the boundless nuclear arms race.[26] In 1958, the three nations initiated negotiations on a comprehensive test ban treaty with the objective of preventing nuclear tests that could potentially trigger a disaster.[27] The deliberations on the treaty were inconsistent and endured until the signing of the PTBT in 1963.[28] The Partial Test Ban Treaty (PTBT) prevents nuclear testing in outer space, the atmosphere and underwater but not underground. It is significant in space law as it explicitly bans nuclear weapon tests in space.[29] PTBT's consequences on the ensuing treaties stress the interconnectedness between arms control and space-related matters in international jurisprudence.[30]

1.6 The Outer Space Treaty and the Moon Treaty

The Outer Space Treaty (OST) is the foundational framework of international space law that governs outer space activities. Proposed to the UN by the USSR and the US in 1966, the OST sets up general principles applicable to the exploration and use of outer space and applies to activities carried out by governmental or nongovernmental entities.[31] OST, rooted in principles

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[26] Lior Lehrs, "Norman Cousins and US–Soviet–British negotiations on a Nuclear Test Ban Treaty, 1962–1963" in *Unofficial peace diplomacy: Private peace entrepreneurs in conflict resolution processes*, 1st ed. (Manchester University Press, 2022) at 71.

[27] James Goodby, "The Limited Test Ban Negotiations, 1954–63: How a Negotiator Viewed the Proceedings" (2005) 10:3 International Negotiation 381–404 at 383.

[28] Arundhati Ghose, "The Comprehensive Nuclear Test Ban Treaty: Intricate Moments during the Negotiations" (2013) 8:2 Ind. For. Aff. J. 213–222 at 218.

[29] F Ronald Cleminson, "*The Feasibility of Space-Based Remote Sensing in the Verification of a Treaty to Prevent an Arms Race in Outer Space*," in Rudolf Avenhaus, Reiner K. Huber & John D. Kettelle, *Modelling and Analysis in Arms Control*, 2nd ed. (Berlin: Springer, 2011) at 52.

[30] Benjamin S. Loeb, *"*The Limited Test Ban Treaty*"* in Michael Krepon & Dan Caldwell, *The Politics of Arms Control Treaty Ratification,* 1st ed. (New York: Palgrave Macmillan US, 1991) at 167.

[31] Michael B. Runnels, "Protecting Earth and Space Industries from Orbital Debris: Implementing the Outer Space Treaty to Fill the Regulatory Vacuum in the FCC's Orbital Debris Guidelines" (2023) 60:1 Am Bus LJ 175–229 at 179.

of peaceful exploration, grants all nations the freedom to explore space for the common good[32], explicitly prohibiting sovereignty claims over celestial bodies.[33]

Enacted in 1979, the Moon Treaty declares the moon and its resources as humanity's common heritage. It seeks an international framework for resource appropriation, ensuring equitable benefits, with a focus on developing nations and contributors to exploitation.[34] The treaty primarily addresses the moon and celestial bodies, rather than the broader scope of outer space.[35] The treaty hasn't been endorsed by the principal space powers, but it is an extension to the undisputed Outer Space Treaty of 1967.[36] While the treaty grants permission for the procurement of lunar resources, the standards for this exploitation are still ambiguous and demand further enhancement.[37]

International relations particularly involving space-faring nations have been markedly affected by the Outer Space Treaty and the Moon Treaty. These treaties were adopted at a time when space activities were limited, and since then, there has been a rapid expansion of space activities that were not foreseen at the time of their adoption.[38] However, the development of international conventional space law has stagnated, and there has been a shift towards soft-law

[32] Catharine A. Conley, "Outer Space Treaty" in *Handbook on Space Law*, 1st ed (Edward Elgar Publishing, 2015) at 25.

[33] Henry R. Hertzfeld et al, "Outer Space: Ungoverned or Lacking Effective Governance? New Approaches to Managing Human Activities in Space" (2016) 36:2 SAIS Rev Int'l Aff 15–28 at 21.

[34] Stephan Hobe et al, "The 1979 Agreement Governing the Activities of States on the Moon and Other Celestial Bodies" in *Cologne Commentary on Space Law Rescue Agreement, Liability Convention, Registration Convention, Moon Agreement,* 1st ed. (Germany: Carl Heymanns Verlag, 2013) at 47.

[35] Carl Q. Christol, "The Moon Treaty Enters Into Force" (1985) 79:1 Am J Int'l L 163 at 164 (JSTOR).

[36] N. Jasentuliyana, "The UN space treaties and the common heritage principle" (1986) 2:4 Space Policy 296–301 at 299 (Science Direct).

[37] E. Gagerro & R. Ripoll, "Agreement governing the activities of states on the Moon and other celestial bodies" (1981) 5 Disarmament and Related Treaties 709–726 at 715.

[38] Naoko Yamazaki, "Space Diplomacy from an Astronaut's Viewpoint" (2023) 18 Hague J Diplomacy 457–463 at 459.

guidelines instead of treaty-based rules.[39] Some principles included in the United Nations space law treaties have gained the status of customary international law, which can amend or invalidate certain provisions of a treaty.[40]

1.7 Emerging Issues in Space Law

Given the advancements in space technology and exploration, potential challenges and changes that might need to be addressed in future space law treaties include: ensuring the long-term sustainability of space activities and the space environment[41], implications of public-private partnerships and competition in the commercialization of outer space[42], addressing legal problems related to responsible behaviour, cyber threats, and the extraction of space resources[43], considering disaster and health risks in outer space and integrating knowledge and experience from Earth[44], and reflecting on the theological implications of developments in science and technology in the context of space exploration. These challenges and changes require the development and strengthening of international legal frameworks, incorporating the needs and interests of developing countries, and ensuring equitable, inclusive, and sustainable development in space activities.

[39] Hertzfeld, *supra* note 33 at 26.

[40] *Ibid* at 15.

[41] Matjaz Nahtigal, "Outer Space Treaty Reform and the Long-Term Sustainability of Space Exploration" (2022) 59 Teorija in Praksa 42–59 at 43.

[42] N. Malysheva & A. Hurova, "Long-Term Sustainability of Space Activities: New Challenges For International And National Space Law" (2022) 28 Kosmičnanauka ì tehnologìâ 63–73 at 65.

[43] Myles Harris et al, "Addressing Disaster and Health Risks for Sustainable Outer Space" (2022) 19 Integr. Environ. Assess. Manag. 994-1001 at 994.

[44] José G. Funes, "The human future. Space exploration, cooperation, and challenges ahead" (2022) 61:2 Dialog 102–106 at103.

1.8 Definitional Issues in Space Law

Ambiguous terms in space law can arise due to inconsistencies between international treaties and national laws, as well as unclear requirements and scopes in both international and national law Technical terms in space law can also be misinterpreted, leading to potential misunderstandings and challenges in international cooperation.[45] These examples highlight the need for clear definitions in different languages, comprehensive lists of space-related technical terms, and easy accessibility to resources for accurate interpretation of space law.[46]

Definitional issues in space law concerning dual-use satellites arise due to the complex nature of these satellites, which have both civilian and military applications. International space law categorizes dual-use satellites as space objects.[47] The definition of 'space objects' in international space law, encompassing various man-made items in outer space, is notably ambiguous, particularly in the context of dual-use satellites. The evolving nature of space activities adds complexity, creating ambiguity that becomes crucial when examining the provisions of the Liability Convention on damage liability. .[48] The dissonance between the current uses of space objects and the underlying rationale of international law creates practical problems, particularly in relation to registration and liability.[49]

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[45] Iván Almár, *Further Applications of Space Terminology and their Interest for the Space Community* (Germany: Aerospace Research Central, 2003) at 69.

[46] Christopher J. Borgen, "Space law and diplomacy" in *Research Handbook on Law and Diplomacy* (Edward Elgar Publishing, 2022) at 226.

[47] Shakeel Ahmad, Fozia Naseem & Ahsan Riaz, "Fragmented International Law and Uncertainties Related to Dual Use Space Technology" (2022) VII Global Legal Studies Review 81–87 at 82.

[48] Martha Mejía-Kaiser, "Space Law and Hazardous Space Debris" in *Oxford Research Encyclopaedia of Planetary Science,* 1st ed. (Rochester, NY: Oxford University Press, 2020) at 53.

[49] Joseph N. Pelton, "Exploring New Approaches and Solutions to the Orbital Space Debris Problem" in Joseph N. Pelton, *New Solutions for the Space Debris Problem Springer Briefs in Space Development,* 1st ed. (Cham: Springer International Publishing, 2015) at 31.

1.9 The Concept of Peaceful Purposes

The definition of 'peaceful purposes' in space law has evolved. Initially, it encompassed not only the prohibition on the use of force but also other customary international law principles that enhanced non-aggression.[50]. The term "peaceful" in the 1967 Space Treaty and 1979 Moon Treaty has evolved amid geopolitical and technological changes, reflecting a shift from defensive to offensive postures in space. The current definition aligns more with the concept of "non-aggression" in the law on the use of force.[51]

The issue of space weaponization has tested the concept of peaceful purposes, and there is a need for an international treaty to prohibit weapons in outer space and anti-satellite weapons on Earth.[52] The gradual erosion of international norms, driven by the tension between peaceful intentions and military applications, has led to legal ambiguities and justifications for militarizing space. This shift, influenced by evolving power dynamics and security concerns, is evident in how the term "peaceful" is interpreted within space law.[53]

The evolving political narrative on peaceful purposes underscores the necessity for reevaluating legal norms in space law.[54] Current challenges involve the limited scope of international law in addressing space weapons and dual-use technology, especially concerning small satellite regulation.[55] The blurred distinction between military and non-military uses,

[50] Giulia Persoz, "Mitigating International Norms Through Contestation: Peaceful Purposes in Space Law and the Security Dilemma" (2023) 83 Heidelberg J Int'l L 65–90 at 68.

[51] P. J. Blount, "The shifting sands of space security: The Politics and Law of The Peaceful Uses of Outer Space" (2019) 17 IJIL 1-18 at 3.

[52] Jinyuan Su, "The 'peaceful purposes' principle in outer space and the Russia–China PPWT Proposal" (2010) 26:2 Space Policy 81–90.

[53] Blount, *supra* note 51 at 1.

[54] Ram S Jakhu, Kuan-Wei Chen, and Bayar Goswami, "Threats to Peaceful Purposes of Outer Space: Politics and Law," (2020) 18:1 Astropolitics 22 at 36.

[55] Inesa Kostenko, "Current Problems and Challenges in International Space Law: Legal Aspects" (2020) 5 Advanced Space Law 48-57 at 52.

compounded by the outdated nature of Article IV of the Outer Space Treaty[56], necessitates international dialogue and the development of interim soft law guidelines for regulating military space use.[57]

1.10 The Use of Starlink Satellite by Ukraine

The Starlink venture that is being developed by SpaceX for providing global internet access is a satellite internet constellation. It benefits the network service supply for communication-enabled power system equipment in completely unavailable, expensive and unreliable settings.[58] This project aligns with international space law by adhering to the principles 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 (Outer Space Treaty).[59] The project's collaboration with the International Space Station National Laboratory and its compliance with ISS requirements demonstrate its commitment to international space governance.[60] However, a recent revelation by US and European intelligence sources indicates that Ukraine's use of the Starlink satellites ensures high efficiency of interaction between the Armed Forces of Ukraine and the NATO command, aiding military operations.[61] Russia's shift underscores the military utility of dual-use satellites for Ukraine, with Starlink's commercial satellites proving resilient

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[56] Irmgard Marboe, "Small Is Beautiful? Legal Challenges of Small Satellites" in Patricia Margaret Sterns & Leslie I Tennen, *Private Law, Public Law, Metalaw and Public Policy in Space, Space Regulations Library,* 1st ed. (Cham: Springer International Publishing, 2016) 1-16 at 4.

[57] Anél Ferreira-Snyman, "Selected Legal Challenges Relating to the Military Use of Outer Space, with Specific Reference to Article IV of the Outer Space Treaty" (2015) 18 Potchefstroom Electron. Law J. 487-529 at 504.

[58] Duan Tong & Venkata Dinavahi, "Starlink Space Network-Enhanced Cyber–Physical Power System" (2021) 12:4 IEEE Trans Smart Grid 3673–3675 at 3674.

[59] *Ibid* at 3674.

[60] Elina Morozova & Yaroslav Vasyanin, "International Space Law and Satellite Telecommunications" (2019) Oxford Research Encyclopaedia of Planetary Science 1-24 at 11.

[61] Lila Paulou, "How Elon Musk's Satellite System Changed The War In Ukraine", (19 Jun 2022) at para 4, online: *World Crunch* <https://worldcrunch.com/starlink-ukraine>.

and difficult for Russia to disrupt in military actions.[62] Russia's military campaign in Ukraine is faltering, attributed in part to Western support, particularly from North American and Western European countries. This aid includes military weapons and crucial access to dual-use satellites supplying vital data for Ukraine's military.[63] Ukraine, with nascent space capabilities, strategically utilizes dual-use assets from the US and Europe for reconnaissance, communication, surveillance, and intelligence, countering Russia despite its superior space capabilities.[64] Ukraine's survival hinges on commercial satellites like Starlink, as it is challenging to envision the country challenging Russia militarily without these crucial assets.[65]

Russia's threat to destroy Starlink satellites underscores their perceived threat to national security, particularly given their pivotal role in Ukraine's successful defense. This situation exemplifies the contemporary challenges and complexities associated with the dual-use phenomenon in satellites during geopolitical conflicts and the strategic positioning of LTACs, offering a compelling real-world study.

1.11 Overview of IHL and its Unique Application in Space Warfare

IHL refers to the intricate legal framework consisting of mutually binding rules[66] and principles governing the conduct of international and non-international armed conflicts and includes the

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[62] Tara Brown, "Can Starlink Satellites Be Lawfully Targeted?" (5 August 2022) at para 14, online: *Lieber Institute West Point* <https://lieber.westpoint.edu/can-starlink-satellites-be-lawfully-targeted/>.

[63] Julia Siegel, "Commercial satellites are on the front lines of war today. Here's what this means for the future of warfare." (30 August 2022) at para 7, online: *Atlantic Council* <https://www.atlanticcouncil.org/content-series/airpower-after-ukraine/commercial-satellites-are-on-the-front-lines-of-war-today-heres-what-this-means-for-the-future-of-warfare/>.

[64] "How commercial satellites are shaping the Ukraine conflict", (4 March 2022) at para 5, online: *Surveying and Geospatial Engineering (SAGE)* <https://www.sage.unsw.edu.au/news/how-commercial-satellites-are-shaping-the-ukraine-conflict>.

[65] *Ibid* at para 6.

[66] Jann Kleffner, "The unilateralization of international humanitarian law" (2022) 104:920 Int'l Rev Red Cross 2153–2169 at 2156.

protection of civilians who can no longer participate in these conflicts.[67] The principles of humanity and military necessity are the two fundamental principles that form the fabric of IHL.[68] The principle of military necessity acts as a restraint on the scope of acceptable actions insisting that force should only be used in achieving direct goals in a conflict and should be proportionate to the goal causing no unnecessary suffering.[69] In contrast, the principle of humanity puts a check on the actions that might be justified by the principle of military necessity.[70] It necessitates that military actions in the course of conflict should minimize loss of life, uphold a basic standard of humane treatment for the captured and injured soldiers and provide maximum protection to the civilians not participating in the conflict. These two principles can conflict with each other and their application in complex situations could be complicated by their general nature.[71]

The three operational principles of distinction, proportionality and precaution in attack have been derived from the two core principles to assist with the application of the two in complex situations.[72] The principle of distinction embodied under Article 48 of Additional Protocol I as 'Basic Rule' dictates that parties to a conflict should continually make a distinction between civilians and combatants and civilian and military objects to guarantee respect and protection to them.[73] The principle of proportionality embodied under Additional Protocol I specifically

[67] Dale Stephens & Cassandra Steer, "Conflicts in Space: International Humanitarian Law and Its Application to Space Warfare" (2016) 40 McGill Annals of Air and Space Law 71 at 84.

[68] *Legality of the Threat or Use of nuclear weapon*s, (1996) ICJ Reports 1996, p 226.

[69] Yoram Dinstein, *The Conduct of Hostilities under the Law of International Armed Conflict*, 4th ed (Cambridge: Cambridge University Press, 2022) at 12.

[70] Charles IV Pendleton Trumbull, "Analogies in Detentions: Distorting the Balance between Military Necessity and Humanity" (2018) 58 Va. J. Int'l L. 97 at 126-127.

[71] Stephens, Steer, *supra* note 67 at 78.

[72] *Ibid* at 79.

[73] Protocol Additional to the Geneva Conventions of 12 August 1949, and relating to the Protection of Victims of International Armed Conflicts (Protocol 1), 8 June 1977, 1125 UNTS 3, 1991 ATS No 29/16 ILM 1391 (1977) (entered into force 7 December 1978) [Additional Protocol I or API].

Article 51(5)(b) as “Protection of the Civilian Population” prohibits indiscriminate attacks. It refers to any attack that can potentially lead to resultant loss of civilian life, injury to civilians, damage to civilian objects or a combination of these which would be disproportionate to the anticipated actual and direct military advantage.[74] The principle of proportionality embodied in Article 57 (2) (ii) of Additional Protocol I stipulates that to prevent or at least minimize injury to civilians, impairment of civilian objects and consequential loss of civilian life combatants must take all the necessary precautions in deciding on the method and means of attack.[75]

The complexities of space warfare emphasize the necessity of thoroughly evaluating the adaptability of conventional legal principles to conflicts occurring beyond Earth's atmosphere. While international law regulates both national and international armed conflicts[76], its application to outer space-based conflicts presents unique challenges due to the distinctive nature of the domain.[77] Consequently, applying specific principles and rules of IHL in this context can be particularly challenging. The principles of proportionality, distinction and precaution are applicable to space-based armed conflicts as well however they require careful consideration.[78] In addition, the unique challenges of applying IHL to space warfare factors including but not limited to the physical environment of space, dual-use satellites, consequences of the kinetic attack and precautions and military decision-making need to be addressed.[79] Since the space environment is very dissimilar from the earth’s surface and space warfare entails the risk of generating space debris from the use of kinetic weapons, the principles of proportionality and precaution in attack must be significantly emphasised in

[74] *Ibid,* Article 51 (5) (b).

[75] *Ibid*, Article 57 (2) (ii).

[76] Usman K, “IHL in the era of climate change: The application of the UN climate change regime to belligerent occupations” (2023) Int. Rev. Red Cross. 1071-1091 at 1074.

[77] Stephens, Steer, *supra* note 67 at 78.

[78] *Ibid* at 83.

[79] *Ibid* at 81.

minimizing such risk.[80] Since dual-use assets (having both civil and military applications) make it difficult to draw a clear distinction between military and civilian objects which in turn makes it problematic to identify objects as legitimate military targets, the principle of distinction needs to be applied diligently. Furthermore, the principle of precaution plays a vital role in military decision-making to minimize civilian casualties and loss of property, however, space warfare is governed by a limited number of treaties and the application of the general principles of IHL in this context requires critical analysis of these principles and the situation at hand. In view of the preceding discussions, IHL should be used in conjunction with the Outer Space Treaty to effectively scrutinize weaponization and militarization of outer space.[81]

1.12 Conclusion

The primary objective of this thesis is to utilize the Ukraine-Russia conflict as a case study for a comprehensive examination of the international legal implications concerning dual-use space assets when it comes to countries with less technological advancement. This research aims to shed light on the legal obligations binding on Russia within the context of the Russia-Ukraine war under IHL, particularly in its confrontation with an adversary, Ukraine, which possesses significantly more advanced space assets.

This thesis will extensively analyse key IHL principles, essential components that offer insights into the level of protection they may provide to Ukraine, identified as a LTAC, against a superior space-capable adversary like Russia. This research will examine the defensibility of Russia's actions in the Ukraine-Russia conflict within international law, analysing frameworks like the Outer Space Treaty and assessing their impact on the use of space assets. Specifically, it will delve into the legal dimensions of dual-use satellites, space militarization, and principles

[80] *Ibid* at 79.

[81] Ryan Esparza, "Event Horizon: Examining Military and Weaponization Issues in Space by Utilizing the Outer Space Treaty and the Law of Armed Conflict" (2018) 83:2 J Air L & Com 333 at 336.

like non-aggression and peaceful use of outer space. The study aims to enhance our understanding of the complex legal mechanisms surrounding space assets in armed conflicts, with a focus on implications for technologically less developed nations like Ukraine. In summary, the thesis comprehensively explores the international legal aspects of dual-use space assets in the Ukraine-Russia conflict, evaluating protective measures for Ukraine, the application of key IHL principles, and the justifiability of Russia's actions.

A. Research Question

This thesis's main research question is: How does the dual-use phenomenon of satellites affect the application and effectiveness of IHL in space warfare, particularly for less technologically advanced states? This question is pertinent and significant because it fills a gap in the existing literature on the interaction of IHL and space law, as well as the implications of space warfare for global security and stability.

B. Theoretical Framework

This study has both a theoretical and policy orientation. It is rooted in the crossroads of international humanitarian law, space law and the dual-use phenomenon. In this regard, the study will rely on a theoretical framework with a policy perspective. At the international level, the world works under an international framework in which States relate to and work with each other.[82] International law comprises treaties and agreements between nations which help in establishing cooperation among nation-states and govern the relationships and interactions between different nations.[83] The law of armed conflict commonly known as IHL is a part of Public International Law.[84] There are a variety of methodological and theoretical approaches

[82] Rebecca M M Wallace & Olga Martin-Ortega, *International Law*, 9th ed (Sweet & Maxwell, 2020) at 59.

[83] Oscar Schachter, "International Law in Theory and Practice" in *International Law in Theory and Practice,* 1st ed. (Brill Nijhoff, 1991) at 45.

[84] "International Humanitarian Law", (14 June 2012), online: *International Justice Resource Center* <https://ijrcenter.org/international-humanitarian-law/>.

to scrutinize and interpret the substance, formation and efficacy of public international law. The International Legal Process (ILP) and the New Legal Process (NLP) are two distinct approaches to the international legal process. The NLP is the predecessor of the ILP.[85] The ILP emphasises understanding the operation of international law.[86] The legal process (LP) was first established in the US in the 1930s to substitute the legal realism school (LRS) in analysing positive law. It was modified with respect to international law in the 1960s and started to be known as the ILP.[87] Critics of the ILP pointed out the lack of normative aspect in this approach, i.e., what ought to be done. Thus, the NLP was born. The NLP focuses on how international law works as well as on how it should work. This means that it not only analyses how international law operates currently but also considers how it should operate in real world scenarios. It focuses on the practical application of laws as well as their intended goal. According to Mary Ellen O'Connell[88], the ILP focuses on understanding how the rules of international law are used by foreign policymakers.

This study will utilize the new legal theory process (NLP) to describe the current events in the Ukraine-Russia war and their implications for humanitarian law.[89] By applying IHL to the war, it would be possible to understand its actual functioning and effectiveness in the realities of the conflict.[90] In the same vein, by applying the NLP, it would be possible to understand how the

[85] Mary Ellen O'Connell, "New International Legal Process" (1999) 93:2 Am J Int'l L 334–351 at 345.

[86] Janne Elisabeth Nijman, "Non-State Actors and the International Rule of Law: Revisiting the 'Realist Theory' of International Legal Personality" (2009) ACIL 2-40 at 5.

[87] *Ibid* at 15.

[88] O'Connell, *supra* note 85 at 345.

[89] Edward L Rubin, "The new legal process, the synthesis of discourse, and the microanalysis of institutions." (1996) 109:6 Harv. L. Rev. 1393-1438 at 1395.

[90] Yusuf Aksar, *Implementing International Humanitarian Law: From The Ad Hoc Tribunals to a Permanent International Criminal Court*, 1st ed (London: Routledge, 2004) at 34.

IHL is supposed to work in the context of the war.[91] This study examines the application of International Humanitarian Law (IHL) to dual-use satellites in armed conflict, specifically investigating the constraints it provides for Ukraine, a technologically less advanced country (LTAC), in its confrontation with Russia.[92] As such, the research concerns itself, not with matters of explanation and causality[93], but rather with a framework that supports questions of evaluation and normative recommendation.[94] The research goes beyond explaining why things happen and what causes them by aiming to provide a framework for assessing and making recommendations about what should be done. The study will go further by exploring how IHL can be adjusted to address the issues faced in this war and future conflicts.

C. Research Methodology

The study will employ a multifaceted approach combining doctrinal (black letter)[95] and textual analysis approach which focuses on the letter of the law.[96] Using the doctrinal approach,[97] the study will aim to gather, collate, describe, and interpret international law on armed conflict and conflict in space and relate it to the Ukraine-Russia war and identify any lacuna that may

[91]Tristan Ferraro, "The applicability and application of international humanitarian law to multinational forces" (2013) 95:891–892 Int'l Rev Red Cross 561–612 at 567.

[92] Steven Freeland, "In Heaven As On Earth? The International Legal Regulation Of The Military Use Of Outer Space" (2011) 8:3 US-China L Rev 272–287 at 274.

[93] Steven Freeland & Elise Gruttner, "The Laws of War in Outer Space" in *Handbook of Space Security: Policies, Applications and Programs,* 1st ed (Cham: Springer International Publishing, 2020) at 59.

[94] Sanne Taekema, "Theoretical and Normative Frameworks for Legal Research: Putting Theory into Practice" (2018) Law and Method 1-16 at 4 (SSRN).

[95] Jack Fox-Williams, *Doctrinal Legal Research: What Does It Entail and Is It Still Relevant to Law?* (Rochester, NY, 2016) at 52.

[96] Debashree Chakraborty, "Empirical (non-Doctrinal) Research Method and Its role in Legal Research" (2015) 3:1 Adv. soc. sci. 23–28 at 25.

[97] VM Gawas, "Doctrinal legal research method a guiding principle in reforming the law and legal system towards the research development" (2017) 3 Int'l J L 128–130 at 139.

exist.[98] This approach will incorporate comprehensive scrutiny of existing literature on international law. The study will aim to identify discrepancies and inconsistencies within the law sources of data include international treaties and covenants, scholarly articles, case laws, current newspaper articles, commentaries, reports from international organizations and empirical data on the Russia-Ukraine war.

D. Rationale

The rationale of this study is underscored by the current Russia-Ukraine war, a pressing issue that is testing the boundaries, resilience, effectiveness, and adaptability of IHL and space law. This research endeavours to dissect and unravel the complexities associated with the enforcement of IHL in space wars.

E. Objectives of the Study

This thesis will endeavour to demonstrate the dual-use phenomenon affiliated with satellites for peaceful and military purposes and its ramifications for LTACs. It will explore the applicability of IHL principles for instance proportionality, distinctions, and precaution in the context of space warfare. Furthermore, it will examine the extent and impact of dual-use assets in the backdrop of the ongoing Russia-Ukraine war while assessing its impact on IHL.

F. Thesis Organization

This thesis is organized into six chapters as follows:

Chapter One: Introduction: The introduction presents the central issue of this thesis: the dual-use phenomenon. It sets the stage by discussing the current stance of Putin regarding the Starlink satellite and its use by the Ukraine military and the Ukraine population. The introduction then provides a brief overview of the implication of the Ukraine-Russia war for

[98] Anja Lindroos, "Addressing Norm Conflicts in a Fragmented Legal System: The Doctrine of Lex Specialis" (2005) 74 Nordic J Int'l L 27–66 at 29.

space war, and the law of armed conflict (LOAC)/IHL. The introduction states the legal question: What is the humanitarian law implication for less technologically advanced states during an armed conflict in pace? A case study of the Ukraine-Russia War. The chapter ends by outlining the methodology to be employed, the significance of the study, the objectives, and the full thesis that follows in the next chapters.

Chapter Two: Arms Race in Space: The chapter discusses how LTAC will be impacted by a space war by providing a discussion of the Ukraine-Russia war. This chapter explores the militarization of space, focusing on the placement of weapons and the ensuing arms race. It provides a detailed discussion of the potential for space warfare, including the definition of weapons and relevant laws. The chapter then discusses the meaning of a war in space by providing the three types of war that are considered space war; destroying or incapacitating space assets from Earth, using space assets to destroy other space assets, and using space assets to fight a war on Earth.

Chapter Three: The Laws of Armed Conflict/IHL and Space War: This chapter reviews the laws of armed conflict/international humanitarian law, in particular the principles of proportionality, precaution, and distinction, and discusses the law of neutrality and their application to a war conducted in space. The chapter also discusses the UN Charter on self-defence and State responsibility in context of space warfare

Chapter Four: Dual-Use Assets in Space: This chapter provides a detailed discussion of the concept of dual-use assets in space. The chapter defines dual-use and provides a historical perspective of dual-use assets; how States have defined, understood, and applied the concept of dual-use, and the laws defining the placing of military assets in space. The chapter also provides data on spacefaring nations and their assets in space.

Chapter Five: Are IHL Principles Sufficient to Protect Less Technologically Advanced Countries (LTACs)? This chapter asserts that IHL Principles are Inadequate to Protect LTACs. Building on Chapter Four, this section addresses the role of IHL principles in the Ukraine-Russia conflict, specifically examining their deterrent impact on space-based dual-use assets for Ukraine, a LTAC. The chapter will assess the application of each IHL principle in the current war by examining events and determining their alignment or conflict with these principles. How does the principle of proportionality apply to current attacks on civilian infrastructure in Ukraine using space assets? What legal implications arise from the UNGA's condemnation of the Russian invasion for the law of neutrality? How does neutrality law affect the US and EU in providing aid to Ukraine as an LTAC? Additionally, how would IHL principles apply if Russia decides to destroy assets like Starlink, providing crucial data to Ukraine? The chapter will critically address the issue of whether the current laws need to be updated to reflect the realities of space war and the implications for LTACs.

Chapter Six: Conclusion: This section provides conclusions, research shortcomings, and suggestions for future research.

CHAPTER II - ARMS RACE IN SPACE

2.1 Introduction

The exploration of space has emerged as a pivotal frontier in international relations and global security, reshaping the dynamics of cooperation and conflict. Within the "Arms Race in Space" chapter, a nuanced exploration unfolds, delving into the intricate realm of space militarization and weaponization. The chapter meticulously probes the ramifications for nations with limited

technological capabilities in an era marked by heightened space weaponization. Through a comprehensive case study focused on the ongoing Russia-Ukraine conflict, the challenges faced by governments with constrained space capabilities in navigating the complexities of the evolving space landscape are dissected.

This chapter provides a meticulous examination of the dual-use characteristics of space technology and their influence on IHL, especially concerning nations with potentially limited technological capabilities. As countries cultivate this capability, the line between military and civilian applications in space becomes increasingly indistinct, often concealing aggressive objectives behind a façade of benign exploration. This transformative shift ignites crucial debates surrounding the moral, legal, and humanitarian implications associated with the notion of space combat.

At its core, the chapter revolves around three fundamental assertions. Firstly, it posits that the militarization and weaponization of space introduce substantial challenges to the security and stability of space, fostering an environment susceptible to conflict. Secondly, despite well-meaning intentions, the existing framework governing weaponry in outer space lacks the requisite authority to effectively grapple with the pressing issue of weaponization, thereby exposing vulnerabilities that adversaries can exploit. Lastly, the chapter argues that engagement in space warfare, particularly among technologically disparate nations, gives rise to numerous legal and humanitarian dilemmas, eroding established norms in both space law and broader international relations.

This chapter is divided into three sections. The initial segment, "Space Weaponization and Militarization," discerns between space weaponization, deploying offensive armaments in space, and space militarization, utilizing space assets for terrestrial military operations. In the subsequent part, "Space Arms Control and Legal Framework," an evaluation of current space

arms control initiatives and agreements takes place. The analysis considers their advantages and constraints, proposing potential enhancements for future effectiveness. In the concluding part, "Modern Space Warfare: A Comprehensive Overview," a deeper exploration into space conflict is undertaken, emphasizing its impact on nations with limited technological advancement.

2.2 Space Militarization vs. Weaponization: Definitions and Distinctions

Militarization and space weaponization are distinct concepts, and their precise boundary is debatable.[99] However, establishing a clear separation is crucial.[100] "Space militarization" refers to a nation's interests and military presence in space, denoting its established foothold. On the other hand, "space weaponization" denotes a more aggressive and involved stance as well as the active use of weaponry.[101] The phrase 'military activities' or 'military operations' in the context of outer space refers to the employment of space-based capabilities to support terrestrial military endeavours and does not intrinsically suggest the placement of armaments in outer space. It includes missile threat warnings, providing precise navigation, instant global communications intelligence gathering, and surveillance and reconnaissance. Such uses of space systems are generally known as the 'militarization of outer space.'[102] A minority of legal academics perceive the militarization of outer space as a breach of the prevailing space law

[99] Michael Mineiro, "The United States and the Legality of Outer Space Weaponization: A Proposal for Greater Transparency and a Dispute Resolution Mechanism" (2008) 33 Annals Air & Space L 441 at 449.

[100] Michael Krepon, & Christopher Clary, "Is the Weaponization of Space Inevitable?" in *Space Assurance or Space Dominance?: The Case Against Weaponizing Space,* 1st ed. (Stimson Center, 2003) 1 at 30.

[101] Lauren Hauck, "The Rogue One: Trump's Space Force and the Threat of a New Cold War" (2019) 42 U Haw L Rev 119 at 133.

[102] C.M. Petras, "The Debate Over the Weaponization of Space – A Military-Legal Conspectus" (2003) 28 Annals Air & Space L 171 at 173.

statutes, whereas a majority of scholars in this field contend that such militarization aligns with the established legal framework governing outer space.[103]

Technology not only enhances the modalities and instruments of warfare in dimensions such as "destructive capacity, reach, discernibility, or accuracy," but also simultaneously cultivates novel alternatives for these methods and instruments.[104] From the inception of space exploration, the military potential of space was acknowledged and served as a catalyst for the early ventures into the extraterrestrial realm.[105] The militarization of outer space is perceived as assuming a position of "strategic superiority" in the context of terrestrial dynamics.[106] Within the framework of armed conflict, the distinctive characteristics of outer space, including continuous surveillance and worldwide reach, can be exploited by the parties engaged in the conflict.[107] Unlike terrestrial infrastructure, space-based objects exhibit a marked immunity from similar shortcomings.[108] This is because of the distinctive characteristics (worldwide reach, continuous surveillance) of space based objects unlike terrestrial infrastructure which makes them less prone to vulnerabilities such as cyber-attacks, sabotage or physical destruction.

[103] Fabio Tronchetti, "Legal Aspects of the Military Uses of Outer Space" in *Handbook of Space Law* (Edward Elgar Publishing, 2015) 331 at 333.

[104] Hitoshi Nasu, & Robert McLaughlin, "*New Technologies and the Law of Armed Conflict,* 1st ed (The Hague: T.M.C Asser Press, 2014) at 2.

[105] Gemmo Fernandez, "Where No War Has Gone Before: Outer Space and the Sufficiency of the Current Laws of Armed Conflict" (2020) 43 Air & Space L 245 at 247.

[106] Duncan Blake, "The Law Applicable to Military Strategic Use of Outer Space" in Hitoshi Nasu & Robert McLaughlin, *New Technologies and the Law of Armed Conflict* (The Hague: T.M.C. Asser Press, 2014) at 34.

[107] Michael N Schmitt, "International Law and Military Operations in Space" (2006) 10:1 Max Planck UNYB 89 at 94.

[108] Blake, *supra* note 106 at 115.

Conversely, 'weaponization' refers to the stationing of offensive weapons, designed with the specific intention of targeting entities.[109] Anti-satellite missiles (ASATs), lasers employed for damaging satellites, and space-based kinetic vehicles stand as quintessential examples of space weaponization.[110]The legality of such operations is widely contested and considered illicit by the majority of legal scholars and states, owing to their incongruity with the core principles of international and space law.[111] While the militarization of space does not intrinsically pose a threat, the weaponization of space elicits apprehensions about an arms race in space.

2.2.1 Historical Overview

Space capabilities originated in World War II[112], with Nazi Germany's V-2 Rocket serving as an early example.[113] The primitive yet effective technology[114] laid the foundation for advanced rockets developed by the United States and the Soviet Union post-war by drawing upon the expertise acquired from captured German scientists[115], shaping the evolution of ballistic missiles and influencing national security frameworks.[116]

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[109] Mineiro, *supra* note 99 at 449.

[110] Benjamin W Bahney, Jonathan Pearl, & Michael Markey, "Antisatellite Weapons and the Growing Instability of Deterrence" in Eric Gartzke & Jon R Lindsay, *Cross-Domain Deterrence: Strategy in an Era of Complexity* (New York: Oxford University Press, 2019) at 121.

[111] Tronchetti, *supra* note 103 at 334.

[112] Joan Johnson-Freese, *Space as a Strategic Asset*, 1st ed. (Columbia University Press, 2007) at 132.

[113] William J Durch, *National interests and the military use of space* (Cambridge, Massachusetts: Ballinger Pub Co, 1984) at 17.

[114] Robert A Ramey, "Armed Conflict on the Final Frontier: The Law of War in Space" (2000) 48 AFL Rev 1 at 8.

[115] T. A. Heppenheimer, *Countdown: A History of Space Flight,* 1st ed. (New York: John Wiley & Sons, 1997) at 60.

[116] Freeland, *supra* note 92 at 284.

In the 1950s, the development of Intercontinental Ballistic Missiles (ICBMs) triggered a space race between the United States and the Soviet Union.[117] The launch of Sputnik 1 by the Soviet Union in 1957 and Explorer 1 by the United States in 1958[118] marked the recognition of satellite technology's potential in enhancing military capabilities.[119] Space-based systems were conceived for active defense, contributing to military resilience and strategic advantage rather than direct combat. Technological advancements led to the development of counter-measures[120], such as terrestrial anti-missile defense systems in the United States[121] and Soviet tests on proximity-detonating weapons.[122] The Gulf War in 1991 marked a milestone, utilizing satellite communication to augment traditional military communication[123] and initiating the widespread use of satellite capabilities in military operations.[124]

As the reluctance to engage in space warfare diminishes, more states are actively developing capabilities for space warfare.[125] The North Atlantic Treaty Organization (NATO) utilized space-based assets in its campaign in former Yugoslavia for surveillance, intelligence, and communications, indicating a shift towards recognizing space as a distinct theatre of military

[117] Arjen Vermeer, "A Legal Exploration of Force Application in Outer Space" (2007) 46:2 Mil L & L War Rev 299 at 299.

[118] *Ibid* at 299.

[119] Kubo Mačák, "Silent War: Applicability of the Jus in Bello to Military Space Operations" (2018) 94 Int'l L Studies 1 at 3.

[120] Steven A Mirmina, "The Ballistic Missile Defense System and Its Effects on the Outer Space Environment," (2005) 31:2 J Space L 287 at 291.

[121] Ramey, *supra* note 114 at 22.

[122] Jackson Nyamuya Maogoto, and Steven Freeland, "The Final Frontier: The Laws of Armed Conflict and Space Warfare" (2007) 23:1 Conn J Int'l L 165 at 187.

[123] Michael J Muolo, *Space Handbook: A war fighter's guide to space,* 1st ed. (Air University Press, Air University, 1993) 1 at 47.

[124] Mačák, *supra* note 119 at 4.

[125] Howard Kleinberg, "On War in Space" (2007) 5:1 Astropolitics 1 at 1.

operations.[126] Recent satellite detonation tests by India and China[127] have positioned them among a limited group of countries capable of waging war in space[128], joining the ranks of the European Space Agency and Japan.[129]

These are a few additional evolutions in space military activities, apart from the above-mentioned:

- In the 1960's the Corona program played an instrumental role in the evolution of military reconnaissance satellites by providing the United States the ability to conduct covert surveillance operations.[130]
- During the period from the 1960s to the 1980s the United Nations and the Soviet Union conducted tests on Anti-Satellite (ASAT) weapons aimed at denying or undermining the space capabilities of their adversaries.[131]
- The Strategic Defense Initiative (SDI) program of the 1980s popularly known as 'Star Wars' was initiated by the then of the United States, Ronald Reagan to develop technologies for missile defense systems in space and on land to achieve a substantial

[126] Ramey, *supra* note 114 at 22.

[127] Victoria Samson, "India, China, and the United States in Space: Partners, Competitors, Combatants? A Perspective from the United States" (2011) 10:4 India Rev 422 at 423.

[128] Charlotte Mathieu, "Assessing Russia's space cooperation with China and India—Opportunities and challenges for Europe" (2010) 66:3 Acta Astronautica 355–361 at 357.

[129] Stephan Hobe, "The Impact of New Developments on International Space Law (New Actors, Commercialisation, Privatisation, Increase in the Number of 'Space-faring Nations')" (2010) 15:3–4 Unif L Rev 869 at 870.

[130] Max Kuhelj Bugaric, "Radical Technological Innovation in Satellite Reconnaissance: From CORONA to CLASSIC WIZARD" (2019) 32:3 Int'l J Intelligence & Counterintelligence 467 at 470.

[131] Aaron M Bateman, "The Evolution of US Space Weapons During the Cold War" in Wolfgang Mueller & Peter Svik, *Technological Innovation, Globalization and the Cold War,* 1st ed (Routledge, 2022) at 24.

decrease in land-based nuclear weapons and possibly eradicate all nuclear weapons through an all-embracing deal with Soviet leaders.[132]

This initiative raised concerns about a potential space arms race and had overwhelming insinuations for the Anglo-American relationship during the Cold War, given its apparent significance for British national security interests.[133]

- In 2007, China's ASAT test signified a substantial transformation in space weaponization displaying the potential to target satellites effectively. By destroying one of its satellites in this test, China signalled its intent to test other countries' ability to manoeuvre in space.[134] China's increasing reliance on space assets and its desire to guarantee its unhindered freedom of action in space were highlighted by this test.[135]

- The United States economy and military's heavy reliance on satellites, along with other countries' acquisition of space capabilities, led to a change in mindset that recognized space as a domain for war and resulted in the establishment of the United States Space Force (USSF) in 2019.[136]

The United States and the former Soviet Union played pivotal roles in spearheading space weaponry and military activities in outer space, influencing the strategic landscape. China, North Korea, and India have expanded space militarization with advanced technologies,

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[132] William Steding, "Ronald Reagan's Strategic Defense Initiative" in William Steding, *Presidential Faith and Foreign Policy: Jimmy Carter the Disciple and Ronald Reagan the Alchemist (Palgrave Studies in Religion, Politics, and Policy),* 1st ed (New York: Palgrave Macmillan US, 2014) 123 at 123.

[133] Aaron Bateman, "Keeping the Technological Edge: The Space Arms Race and Anglo-American Relations in the 1980s" (2022) 33:2 Diplomacy & Statecraft 355 at 355.

[134] Ashley J Tellis, "China's Military Space Strategy" (2007) 49:3 Survival 41 at 42.

[135] Fredrick Mahler, *China's Anti-Satellite Test: A Precursor to Challenge U.S. Freedom to Maneuver in Space?* (Georgia State University, 2008) [unpublished] 1 at 1.

[136] Katherine Carroll, William B Hickman, *Understanding the U.S. Military*, 1st ed (London: Routledge, 2022) at 34.

while non-state actors like commercial and international groups contribute to space operations, with less emphasis on weaponization. Furthermore, space weaponization has evolved, incorporating advanced capabilities like cyber tools and missile defense systems. Dual-use technologies complicate the distinction between military and civilian applications, with the contemporary scene featuring co-orbital mechanisms, anti-satellite missiles, and electronic warfare. Anticipated developments include directed energy and space-based missile defense systems, raising policy challenges, while the integration of AI and ML increases complexity in space security dynamics, highlighting the need for legal and policy discussions.

2.2.2 Motivations and Drivers

Nations primarily arm and militarize space due to multifaceted national security interests which stems from the recognition of space as the ultimate high ground and the growing reliance on space-based systems for preserving national security. The growing strategic prominence of orbital systems and artificial satellites in conjunction with the evolution of space technologies has necessitated the development of both defensive and offensive space weapon systems and military units.[137]

The rise in space militarization, reflecting the growing strategic significance of space, has led to advancements in space deterrence measures. Space deterrence, now a fundamental element of national deterrence systems and evolving space security strategies, progresses through stages of inception, coexistence, segregation, and consolidation.[138] When applying deterrence theory to space militarization, it suggests that a military presence in space can dissuade potential adversaries from hostile actions, driven by the fear of retaliation or the inability to achieve a

[137] Paweł Bernat, "The Inevitability of Militarization of Outer Space" (2019) 5 Safety & Defense 49 at 51.

[138] Stephen J Flanagan et al, *A Framework of Deterrence in Space Operations* (RAND Corporation, 2023) 1 at 7 (www.rand.org).

swift and conclusive victory. However, the distinctive nature of outer space introduces complications for policymakers and scholars attempting to grasp escalation dynamics and deterrence in this context.[139] Another noteworthy factor influencing a country's decision to pursue space weapons is international prestige.

2.2.3 Challenges and Risks

The complexities arising from space militarization and weaponization demand a comprehensive overhaul of international space law. Technology gaps, legal ambiguities, and the looming prospect of an arms race exacerbate these challenges. Critical terms such as "space," "activities," and "experiment" within the OST lack clear definitions, fostering varied interpretations among state parties.[140] Article IV's definition of "peaceful" is also vague; generally speaking, it means "non-aggressive" rather than "non-military," which allows for the use of space for military purposes.[141] While the OST prohibits the use of nuclear weapons and other weapons of mass destruction in space, it contains a loophole that allows the placement of other types of weapons there.[142] States can now lawfully develop and use anti-satellite weapons thanks to the gap that exists, which increases the likelihood of an arms race in space. While providing state parties with the authority to determine if such consultations are necessary, Article IX of the OST, which outlines an international consultation system, lacks substantive applicability and defined processes.[143] The absence of a robust enforcement mechanism further

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[139] Todd Harrison, Zack Cooper, Kaitlyn Johnson, Thomas G. Roberts, "Escalation and Deterrence in the Second Space Age" (October 3, 2017), online: *Center for Strategic and International Studies* <https://www.csis.org/analysis/escalation-and-deterrence-second-space-age at 19.

[140] Danylo Stonis, “Ambiguities in Space Law as Path towards Weaponization of Space: The Case of the Outer Space Treaty. Remarks on Regulation of Weaponization of Outer Space by Space Law” (2022) 1:4 Copernicus Political and Legal Studies 74 at 81.

[141] M Cervino, S Corradini, S Davolio, “Is the ‘peaceful use’ of outer space being ruled out?” (2003) 19:4 Space Policy 231 at 232

[142] Stonis*, supra* note 140 at 76.

[143] *Ibid* at 81.

amplifies the risk of non-compliance and clandestine military activities in space. Moreover, the evolution of space technologies has fostered a competitive environment where states with advanced space capabilities may attain significant military advantages.[144] The technological race poses global security risks, leading to strategic imbalances that disproportionately affect less technologically advanced nations. The dual-use nature of space technologies complicates regulation and monitoring, potentially allowing covert militarization efforts. The proliferation of space weaponry contributes to increased space debris, posing risks to navigation and satellite assets. The use of kinetic Anti-Satellite (ASAT) weaponry is seen as a major threat to the sustainable use of space, as it raises concerns about accountability for space debris.[145] The existence of space debris threatens the space assets of the possible target and impartial third parties violating their rights under international law.[146] This competitive pursuit of space militarization escalates tensions and conflicts, driven by perceived threats to national security from the deployment of space arms.

2.3 Space Arms Control and Legal Framework

Space arms control involves regulating and limiting the development, deployment, and use of weapons in outer space to safeguard space security and stability. It prevents the militarization of space[147], regulates space-based weaponry to prevent an arms race and conflicts[148], and lowers the risk of space debris.[149] This ensures the full utilization of space assets for military,

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[144] *Ibid* at 82.

[145] Yasmin Ali, "Who owns outer space?", (24 September 2015), online: *BBC News* <https://www.bbc.com/news/science-environment-34324443>.

[146] Edward F Hennessey, "Liability for Damage Caused by the Accidental Operation of a Strategic Defense Initiative System" (1988) 21:2 Cornell Int'l LJ 317 at 330.

[147] Darya Bohdan, "Future Perspectives of International Humanitarian Law Application to State Activities in Space" (2020) 63:7 Int. Inst. Space L. 523 at 528.

[148] Vermeer, *supra* note 117 at 21.

[149] Stacey Henderson, "Arms Control and Space Security" in Kai-Uwe Schrogl, *Handbook of Space Security: Policies, Applications and Programs,* 1st ed. (Cham: Springer International Publishing, 2020) at 95.

economic, and civilian purposes.[150] Arms control regimes provide a framework for communication and collaboration, fostering stability and trust among space-faring countries.[151] This contributes to a sustainable and secure future for space travel, with positive effects on Earthly security.

The main existing and proposed initiatives and agreements for space arms control include the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and other Celestial Bodies (Outer Space Treaty)[152] and the Draft Treaty on the Prevention of the Placement of Weapons in Outer Space and the Threat or Use of Force against Outer Space Objects (Draft PPWT Treaty).[153] Weapons of mass destruction (WMD) are forbidden by the OST, which also applies the non-militarization norm to celestial bodies, thus partially regulating the non-weaponization of space.[154] The Draft PPWT Treaty, which was put forth by China and Russia in 2008, had the objective of prohibiting the deployment and utilization of weapons in outer space.[155] Furthermore, United Nations General Assembly has adopted resolutions urging states to prevent an arms race in space and avoid actions that undermine this objective. These initiatives and agreements aimed at regulating and banning space weapons and military activities in outer space with a view to maintaining its peaceful nature.

[150] Arne Sönnichsen et al, "The Militarization of Space – Unique Opportunities for Arms Control" (2022) 95:3–4 Friedens-Warte 247.

[151] Hong-Je Cho, "Militarization of Space and Arms Control" (2018) 33:2 Korean J Air & Space L & Pol'y 443 at 459.

[152] Bohdan*, supra* note 147 at 528.

[153] Vermeer, *supra* note 117 at 25.

[154] Mitchell Ford, "War on the Final Frontier: Can Twentieth-Century Space Law Combat Twenty-First-Century Warfare" (2017) 39:1 Hous J Int'l L 237 at 237.

[155] Bohdan*, supra* note 147 at 528.

However, there are advantages and disadvantages to the current space weapons control system. The demilitarization of celestial bodies, which are set aside for peaceful purposes, is one of its primary advantages.[156] Nevertheless, it falls short in its ability to adequately and justifiably tackle the issues posed by the militarization and weaponization of outer space, particularly pertaining to military endeavours in the vast expanse between celestial bodies, commonly referred to as the outer void space.[157] Like the existing body of international law that governs space only forbids the use of nuclear weapons and other WMDs; it is unable to stop a conventional arms race in space.[158] The Outer Space Treaty's lack of precise definitions and guidelines makes the system even less effective.[159] Effective rules and treaties to control and regulate these operations have not kept up with the rapid technological improvements in space capabilities.

In order to strengthen and improve the space arms control regime, one potential approach is to include knowledge from a variety of fields, such as international law, physics, engineering, and political science.[160] This multi-disciplinary approach has the capacity to tackle the complexities of space technologies and create a strong foundation for arms control.[161] Opportunities also lie in addressing the gaps in existing treaties and regulations. Strengthening the powers of the Security Council under Chapter VII of the UN Charter can also be a lawful extension to address force application in space by enhancing its capability to respond to threats and maintain peace

[156] *Ibid* at 528.

[157] Shakeel Ahmad, Fazal Rabbi and Ahsan Riaz, "Unresolved Cold War Issues of Contemporary Outer Space Arms Control Efforts" (2022) 5:2 Global Foreign Policies Rev 20 at 26.

[158] Henderson, "Arms Control and Space Security", *supra* note 149 at 87.

[159] Keith Wilson, "Why Are the Missiles (and Missile Defence) Called Peace-Keepers? – Corroding the Concept of Peaceful Use" (2001) 14:4 Leiden J Int'l L 789–828 at 803.

[160] Sönnichsen, *supra* note 150 at 247.

[161] Laura Grego, "The Case for Space Arms Control" in Melissa de Zwart & Stacey Henderson, *Commercial and Military Uses of Outer Space Issues in Space,* 1st ed (Singapore: Springer, 2021) at 81.

and security in outer space.[162] Furthermore, new frameworks and agreements need to be proposed to curb the growing space threat and ensure international acceptance. Various initiatives and agreements strive to regulate and prohibit space weapons and military activities by establishing non-binding rules and norms. United Nations discussions spanning over 30 years have resulted in yearly resolutions urging states to prevent a space arms race, carrying political and moral weight but lacking legal enforceability.

In more recent years, the international community has also proposed initiatives like the International Code of Conduct for Outer Space Activities, which aims to increase transparency and prevent an arms race in outer space.[163] The main actors and stakeholders involved in these initiatives include member states of the United Nations, international organizations like the European Union, and various experts and scholars in the field of space law and policy.[164]

2.4 Modern Space Warfare: A Comprehensive Overview

War in space is understood and distinguished from other forms of conflict and violence in space or on Earth through various factors and can be classified and characterized based on the targets and methods of attack and defense. The execution of military operations in space is defined using space-based infrastructures that are intended to influence other space-based entities such as military satellites that target hostile objects or provide services to friendly assets.[165] There are numerous kinds of space warfare, which can be widely compartmentalized in the following manner:

[162] Ford, *supra* note 154 at 237.

[163] *Ibid* at 237.

[164] Seema Sharma & Malika Tiwari, "Adequacy of International Law for Prevention of Outer Space Weaponization: A Critique" (2021) 4:6 Int'l J L Management & Humanities 743 at 754.

[165] *Ibid* at 5.

- Kinetic space warfare: This includes the use of physical objects, such as missiles, to damage or destroy enemy space assets, such as satellites and can be further classified into two sub-categories: direct ascent and co-orbital.[166]
- Non-kinetic space warfare: This includes the use of non-physical means, such as electronic jamming or cyber-attacks, to disrupt or damage enemy space assets and can also include the use of directed energy weapons, such as lasers, to disable or destroy satellites.[167]
- Space-based intelligence, surveillance, and reconnaissance (ISR): This type of space warfare involves the use of satellites for intelligence gathering, surveillance, and reconnaissance. Such type of information can be crucial in aiding military operations, both on the ground and in outer space.[168]
- Anti-satellite (ASAT) weapons: This includes the deployment of weapons expressly engineered to neutralize adversary satellites and can be either kinetic or non-kinetic. They are capable of being launched from ground-based, airborne, or space-based platforms.[169]

As per these classifications, the idea of war in space deals with the application of military force and the performance of violence within the spatial environment. This could also mean using space assets to fight a war on Earth.[170] Irrespective of the definition of space warfare, the aftermath of a space war could be severe for military forces and the civilian population. A

[166] Todd Harrison, Kaitlyn Johnson and Makena Young, *Defense Against the Dark Arts in Space: Protecting Space Systems from Counterspace Weapons* (Center for Strategic & International Studies, 2021) 1 at 3 (www.csis.org).
[167] *Ibid* at 6.
[168] *Ibid* at 4.
[169] Mark Smith, "Anti-satellite weapons: History, types and purpose", (10 August 2022) at para 7-8, online: *Space.com* <https://www.space.com/anti-satellite-weapons-asats>
[170] *Ibid* at para 3.

disruption of communication and navigation systems could have extensive bearings on transportation, commerce, and other critical infrastructure.

2.4.1 Implications for Less Technologically Advanced States

LTACs could be significantly affected by a space war between them and more technologically advanced countries in numerous ways. Primarily, their deficiency in space capability makes them susceptible to exploitation by enemies possessing more knowledge and expertise in space systems.[171] The use of space assets for military purposes, such as intelligence gathering and surveillance, could impend the sovereignty and security of LTACs, leaving them vulnerable to potential attacks or exploitation without the means for effective defense.[172] Furthermore, a space conflict could lead to the decimation or disruption of essential space-based infrastructure, encompassing systems for communication and navigation, weather monitoring, electrical grids, water supply management, and earth observation satellites.[173] This could have a noteworthy influence on the ability of LTACs to manage their natural resources, respond to natural disasters, and maintain their economic and social infrastructure.[174] Secondly, the dual-use nature of many space technologies makes it difficult for states to distinguish between defensive and offensive preparations or conventional and space weapons, further complicating the situation.[175] Additionally, the dependence on space systems by more advanced States can result in a dramatic degradation of efficiency in combat for LTAC, if their space systems are

[171] Geoffrey Forden, "Viewpoint: China and Space War" (2008) 6:2 Astropolitics 138 at 147.

[172] Peter van Ham, "Ukraine, Russia and European security: implications for Western policy" (2017) at para 4, online: *European Union Institute for Security Studies* <https://www.iss.europa.eu/content/ukraine-russia-and-european-security-implications-western-policy>.

[173] Paulo Pereira et al, "Russian-Ukrainian war impacts the total environment" (2022) 837 Science of The Total Environment 155865.

[174] Madeline Rae, "*The economic impact of the Ukraine-Russia War"* (London: SAGE Publications: SAGE Business Cases Originals, 2022) at 48 (Sage Knowledge).

[175] Kenneth S. Blazejewski, "Space Weaponization and US-China Relations" (2008) 2(1) Strategic Studies Quarterly 33 at 33 (JSTOR).

targeted.[176] Finally, the potential for anonymous attacks and groundless accusations of anti-satellite attacks due to insufficient situational awareness in space and poor forensic ability can further complicate the security[177]. LTACs face potential impacts from a space war, including unsettling consequences for the global political and economic structure, leading to regional disputes and worldwide tensions.[178]

2.4.2 Case Study: Russia-Ukraine War

The Russia-Ukraine war began with the occupation and annexation of Ukraine's Crimean Peninsula by unmarked Russian forces, followed by armed conflict in eastern Ukraine between pro-Russia separatists and the Ukrainian military.[179] Tensions escalated in 2021 and 2022 with a Russian military build-up on the border, leading to a full-scale invasion of the Ukrainian mainland by Russia on February 24, 2022.[180] The war has had significant space-related aspects and incidents.

To comprehend the alleged space war between Russia and Ukraine, it is crucial to examine Ukraine's space history. Following the Soviet Union's collapse, Ukraine inherited key components of the Soviet space industry, including rocket factories and satellite development

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[176] Anél Ferreira-Snyman, "The environmental responsibility of states for space debris and the implications for developing countries in Africa" (2013) 46:1 Comp & Int'l LJ S Afr 19 at 47.

[177] J Caton, "Joint Warfare and Military Dependence on Space" (1996) at 58, online: *Semantics Scholar* <https://www.semanticscholar.org/paper/Joint-Warfare-and-Military-Dependence-on-Space-Caton/45949030d98e09fd8a522d5414d297984bc16b59>.

[178] Vanessa Ratten, "The Ukraine/Russia conflict: Geopolitical and international business strategies" (2023) 65:2 Thunderbird Int'l Bus Rev 265 at 268.

[179] "How the war in Ukraine is affecting space activities" (2022) at para 5, online: *OECD* <https://www.oecd.org/ukraine-hub/policy-responses/how-the-war-in-ukraine-is-affecting-space-activities-ab27ba94/>.

[180] Choi Seonghwan, "Analysis and Aspects of Space Warfare in the Russia-Ukraine War (Russian Invasion of Ukraine) and Considerations for Space Technology Development" (2022) 2 J Space Tech & Applications 169 at 179.

and launch facilities.[181] As a result, Ukraine's space industry has a long history of collaboration with Russia in the development of space technologies, and many Ukrainian companies have provided components and services for Russian space projects.[182] However, Ukraine's space cooperation with Russia substantially declined after the invasion of Crimea in 2014, and it lost access to vital technology produced by Russia. Ukraine no longer has access to vital infrastructure and launch sites that it shared with Russia, such as Kazakhstan's Baikonur Cosmodrome, which served as a vital launch pad for Ukrainian satellites.[183]

Consequently, important dual-use space assets were also lost to Ukraine's space industry.[184] This made it difficult for Ukraine to compete with Russia in the international market and harmed the country's space sector.[185] Additionally, it hindered Ukraine's capacity to participate in international space initiatives and made it more difficult for it to manufacture and launch its satellites.[186] Due of Russia's ability to control the region's space services market, Ukraine has not been able to fully benefit economically from Russia's space sector.[187] Due to this, the space

[181] Roman Krawec, "Ukrainian space policy — contributing to national economic development" (1995) 11:2 Space Policy 105 at 106.

[182] OECD*, supra* note 179 at para 24.

[183] *Ibid* at para 14.

[184] Marko Höyhtyä, & Sari Uusipaavalniemi, "The space domain and the Russo-Ukrainian war: Actors, tools, and impact" (2023) at page 19, online: *The European Centre of Excellence for Countering Hybrid Threats* <https://www.hybridcoe.fi/wp-content/uploads/2023/01/20230109-Hybrid-CoE-Working-Paper-21-Space-and-the-Ukraine-war-WEB.pdf>.

[185] Tereza Pultarova, "Lost partnerships destroying Ukraine's space sector faster than Russian missiles, former space chief says" (August 27, 2023) at para 5-8, online: *Space.com* <https://www.space.com/ukraine-space-sector-threatened-lost-partnerships>.

[186] *Ibid* at para 5.

[187] Andrew Jones, "Russia's war on Ukraine has caused lasting damage to international spaceflight cooperation", (7 March 2023) at para 5, online: *Space.com* <https://www.space.com/russia-war-ukraine-damage-international-spaceflight-cooperation>.

industry in Ukraine has not grown as much, and it is now more difficult for Ukrainian businesses to enter foreign markets.[188]

Losing access to the Russian GLONASS satellite navigation system is one of the biggest obstacles facing Ukraine's space industry.[189] SICH-2, the satellite navigation system designed by Ukraine, was never able to reach full operational capabilities because of budget issues and technical challenges.[190] Therefore, GLONASS was crucial to Ukraine's navigational needs, particularly for military purposes.

On February 24, 2022, Russia launched a full-scale invasion on Ukraine, commencing the largest conventional land war in Europe since World War II. The ongoing conflict has sparked tectonic geopolitical realignments as Western allies rush military aid and heavy weaponry into Ukrainian resistance efforts while imposing extensive multilateral sanctions against Moscow's economy and oligarchs. Beyond ground and air warfare, both Russia and Ukraine also wield advanced capabilities in newer battlegrounds like cyberspace and outer space domains. Russia's vast counterspace arsenal has disrupted Ukrainian communications to enable information dominance and partially isolate Ukraine's military from NATO support. Yet SpaceX's donated Starlink satellite network has partially reconstituted Ukraine's severed connectivity. Around orbital geopolitical skirmishing and control over satellite networks, legal ambiguities swirl regarding infrastructure weaponization amid these unmanned clashes.

The satellite constellation has remained highly resilient against Russian jamming and cyberattacks. Access to the Starlink network has proven invaluable for Ukrainian civilians and

[188] *Ibid* at para 2.

[189] Pavel Luzin, "Multiple Challenges Hinder Russian Efforts to Modernize Its Satellite Navigation System" (2020) at 32, online: *Eurasia Daily Monitor* <https://www.strategicstudyindia.com/2020/05/multiple-challenges-hinder-russian.html>.

[190] *Ibid* at para 3.

essential command, control, and communications links allowing Ukrainian forces to continue coordinating armed resistance and defense operations.[191] Nonetheless, Russia has issued a cautionary statement suggesting that the legal protections afforded to Starlink satellites as purely "civilian" infrastructure may be compromised, contingent upon the level of integration of Starlink technology within Ukrainian military operations.[192] For instance, this integration has reportedly facilitated the interception of Russian battlefield communications, supported Ukrainian command and control (C2) operations, and aided in information warfare efforts, including assisting a Ukrainian drone unit in targeting Russian tanks.[193] Within counter-space operations, satellites can be targeted for various reasons, including disrupting or degrading an adversary's space-based capabilities.[194] This action aligns with the broader strategy of counter-space operations, which aim to neutralize[195] or exploit[196] an adversary's space-based assets to gain a strategic advantage in conflicts. Therefore, Russia's implication suggests that, within the framework of international law governing armed conflicts, these satellites could potentially be targeted as part of counter-space operations aimed at undermining Ukraine's military capabilities.

On the other, while the Soviet Union inaugurated the Space Age by launching history's first artificial satellite, Sputnik 1, in 1957, Russia has lagged in deploying orbital assets ever since. Today, Russia maintains only about 160 total satellites, including around 100 dedicated military

[191] C. Clark, "SpaceX helping shift the balance in Ukraine, says Pentagon official" (7 April 2022) at para 2, online: *Breaking Defense* <https://breakingdefense.com/2022/04/spacex-beating-russian-jamming-attack-was-eyewatering-dod-official/>.

[192] S. Erwin, "Russia's attack on Ukraine tests limits of space law" (8 March 2022) at para 8, online: *SpaceNews* <https://spacenews.com/russias-attack-on-ukraine-tests-limits-of-space-law/>.

[193] Brown, *supra* note 62 at para 4.

[194] Harrison, Johnson, Young, *supra* note 166 at 2.

[195] *Ibid* at 21.

[196] *Ibid* at 19.

satellites.[197] Most Russian satellites feature various communications, signals intelligence, electronic intelligence, early warning, navigation, science, and Earth observation capabilities. However, Russia is pioneering more advanced counterspace systems for disabling or destroying enemy satellites, including direct-ascent anti-satellite (DA-ASAT) missiles, orbital interceptor satellites, directed energy weapons, and electronic warfare packages to disrupt satellite signals. Highly manoeuvrable Russian satellites have previously stalked or interfered with other countries' satellites in orbit, alarming French military officials in 2017.[198] The following year marked a turning point as Russian General Valery Gerasimov formally unveiled Russia's military space strategy[199], under which the Kremlin has accelerated counterspace weapons testing and integration.

Therefore, Russia sees strategic advantages in anti-access/area-denial capabilities that asymmetrically target American dominance in space-enabled navigation, communications, command and control, and intelligence gathering. With Ukraine heavily relying on Western satellite infrastructure, Russia effectively holds such systems hostage. Neither Russia nor leading Western militaries have moved to significantly harden satellite platforms against attack, as kinetic or high-powered microwave attacks were scarcely anticipated in their development but are growing geopolitical concerns.

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[197] P Luzin, "Russia looks to reclaim lost space glory with Angara rocket" (15 September 2020) at para 3, online: *Defense News* <https://www.defensenews.com/space/2020/09/15/russia-looks-to-reclaim-lost-space-glory-with-angara-rocket/>.

[198] J Foust, "Russian satellite's behavior raises flags" (11 September 2018) at para 9, online: *SpaceNews* <https://spacenews.com/russian-satellites-behavior-raises-flags/>.

[199] A Tate, "Russia 'developing satellite attack capabilities' amid fears over space weapons threat" (26 March 2018) at para 4, online: *Newsweek* <https://www.newsweek.com/russia-developing-satellite-attack-capabilities-fears-grow-over-space-weapons-threat-864584>.

In November 2021, Russia conducted its first DA-ASAT missile test since the 1980s, creating a debris cloud of over 1,500 fragments.[200] This test, preceding the invasion of Ukraine, highlighted Moscow's counterspace capabilities and suggested a willingness to dangerously escalate conflicts by targeting satellites. While Russian officials portray these developments as defensive, they signal aggressive intentions as military intimidation tools against states opposing Moscow's foreign policy aims. In contrast with Russia's offensive orientation, Ukraine relies extensively on foreign satellites from commercial providers and allies for communications, internet access, and intelligence support. Russia anticipated exploiting this reliance to tear an informational Iron Curtain around Ukraine, isolate Ukrainian command from Western intelligence feeds, panic citizens under psychological strain, and quick force a capitulation.[201]

Russia's deployment of kinetic and non-kinetic counterspace weapons during the invasion of Ukraine undermined communications infrastructure. SpaceX Starlink donations assisted Ukrainian civilians and military leaders, despite legal uncertainties regarding national security exploitation. Ultimately, governance gaps in the existing space law regime fail to protect declared "peaceful" satellite infrastructure from emerging state-level counterspace capabilities that major militaries like Russia continue developing and testing without constraint. As orbital satellite infrastructure rises in perceived military value but remains largely undefended, the absence of governance guardrails raises risks that skirmishes over terrestrial territory and information dominance may unleash cascading and uncontrolled escalation across humanity's shared orbital domain.

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[200] L. David, "Russia just blew up a satellite. Here's why space junk threatens astronauts" (16 November 2021) at para 7, online: *Space.com* <https://www.space.com/russia-anti-satellite-asat-test-debris-threatens-iss>.

[201] C. Clark, "As internet goes down, space chief begs Elon Musk for Starlink terminals" (28 February 2022) at para 3, online: *Breaking Defense* <https://breakingdefense.com/2022/02/as-internet-goes-down-space-chief-begs-elon-musk-for-starlink-terminals/>.

2.5 Conclusion

Reflecting on the intricate terrain of space weaponization and militarization is crucial, particularly considering its manifold implications for less technologically advanced states. This chapter, anchored in the ongoing Russia-Ukraine conflict, serves as a vital case study, offering insights into the broader impact of space warfare on nations with limited space capabilities.

The chapter underscores the significant threats of space militarization and weaponization to global peace and stability, expressing concerns about inadequate existing control procedures. A careful examination reveals the urgent need for a robust regulatory framework, especially for less technologically advanced states. By highlighting the dual-use nature of space technology and its impact on humanitarian law in space conflicts, the chapter stresses the imperative for heightened security and stability.

The war between Russia and Ukraine is a pertinent example of how terrestrial geopolitical conflicts impact nations in space, regardless of technological capability.

Through this chapter, an attempt is made to present a comprehensive study of how space warfare affects international security, with a focus on nations with low levels of technological development. The results provide important insights for important stakeholders and decision-makers in space activities, and they also add to the continuing scholarly conversation on space law and policy. The chapter lays the foundation for future talks and study in this important area by highlighting the necessity to address issues brought on by the militarization and weaponization of space.

CHAPTER III - THE LAW OF ARMED CONFLICT / IHL AND SPACE WAR

3.1 Introduction

The emergence of space warfare poses unique obstacles to the extant legal structures that oversee armed conflicts in the dynamic domain of warfare. The complex relationship between the rapidly evolving field of space warfare and the laws of armed conflict, generally known IHL is examined in this chapter. The chapter investigates how customary legal principles develop, alter, or run into new challenges when they are applied to disputes that take place outside of Earth's atmosphere.

Understanding the intricacies of IHL principles becomes vital when contemplating their relevance in the realm of space warfare. The principle of proportionality, requiring a careful balance between potential civilian harm and the direct military advantage gained from an attack, gains complexity in the context of space warfare. The interdependence of space assets and elevated stakes necessitate a nuanced assessment of proportional force. Similarly, the foundational IHL principle of precaution, obliging conflict parties to take reasonable steps to prevent civilian harm, faces heightened intricacies. Implementing precautionary measures becomes more intricate, given the close proximity of satellites to potential targets, impacting not only immediate human populations but also critical infrastructures crucial for global functionality.

Beyond IHL, the exploration also extends to the law of neutrality, governing the rights and responsibilities of non-participating states in conflict. As space becomes a contested arena, the traditional notions of impartiality and non-involvement in neutrality laws confront new challenges, especially considering the mutual reliance of nations on space-based assets. The concept of qualified neutrality introduces complexity to traditional laws, prompting a closer

examination of UN Charter provisions, particularly those related to self-defense and state responsibility, in the context of space warfare.

The vulnerabilities of less technologically advanced nations in space warfare underscore the need for a robust legal framework. The Russia-Ukraine conflict highlights the critical role of technological advancements in this evolving landscape, where existing laws are lacking, placing those with superior technology in an advantageous position.

This chapter unfolds in three sections, systematically revealing the intricate interplay between space warfare and the laws of armed conflict. In-depth discussions of these concepts are provided in the first section, "Foundational Principles of IHL in Space Warfare," which also addresses dual-use regulation and the difficulties posed by the "attack" conundrum. It examines the applicability of proportionality, distinction, and precautionary measures in space warfare. The second section, "Challenges to Neutrality in the Space Domain," addresses neutrality complexities in space, exploring limitations of neutrality law, global conflict dynamics, and the applicability of the UN Charter's provisions on self-defense and state responsibility in space warfare. The concluding section, "Space Conflict Dilemmas: Struggles and Vulnerabilities of Less Technologically Advanced Nations," emphasizes the need for a robust legal framework, drawing attention to vulnerabilities exposed in the Russia-Ukraine conflict backdrop, advocating for stronger protection for less technologically advanced states.

In summary, Chapter 3 highlights the shortcomings of traditional IHL as the primary framework for governing legal conflicts in space. The main contention is that whereas IHL principles are fundamental to conflicts on Earth, they fall short in addressing issues raised by dual-use assets in space. This underscores the necessity for a more nuanced and tailored legal framework for space warfare issues.

3.2 Foundational Principles of IHL in Space Warfare

The field of IHL is a complex and multifaceted legal framework that includes legally enforceable guidelines and principles that govern the conduct of armed conflicts that are both international and non-international.[202] It is a comprehensive legal framework governing both international and non-international armed conflicts.[203] IHL, which has its roots in the necessity to humanize warfare, aims to lessen the effects of hostilities on populations that are already at risk, with a particular emphasis on protecting civilians who are unable to take part in these conflicts. [204] In the unique context of space warfare, with interconnected satellite systems and potential collateral damage, safeguarding civilians becomes even more critical.[205]

The UN Charter, conceived in 1945, also establishes principles aimed at maintaining international peace and security.[206] However, it primarily focuses on state-centric concepts of security and does not fully capture the nuanced dynamics of dual-use space technologies.[207] Furthermore, the principles of non-interference and the prohibition of the use of force, as outlined in the Charter, were designed to prevent armed conflicts between states but does not adequately address the intricate interplay between civilian and military applications in the realm of space activities.[208]

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[202] Kleffner, *supra* note 66 at 2163.

[203] Michael Wood, "The Evolution and Identification of the Customary International Law of Armed Conflict" (2018) 51 Vand. J. Transnat'l L. 727 at 727.

[204] Stephens, Steer, *supra* note 67 at 84.

[205] Ramey, *supra* note 114 at 18.

[206] Charter of the United Nations UN Charter, 26 June 1945, Can TS 1945 No 7.

[207] Almudena Azcárate Ortega, "The Cyber Phantom Menace to Space Security", (2023) at para 19, online: *Centre for International Governance Innovation* <https://www.cigionline.org/articles/the-cyber-phantom-menace-to-space-security/>.

[208] Tom Ruys, "The Meaning of 'Force' and the Boundaries of the Jus Ad Bellum – Are 'Minimal' Uses of Force Excluded from UN Charter 2(4)?" (2014) 108:2 Am. J. Int'l L. 159 at 233.

In a similar vein, the law of neutrality, which has historically addressed the obligations and rights of states in armed conflicts, faces challenges in adapting to the changing landscape of space combat.[209] In order to be neutral, one must be able to distinguish between states that are belligerent and those that are neutral; yet, this line might get hazy when discussing dual-use space objects.[210] The increasing reliance on commercial space actors, whose activities may have both civilian and military implications, challenges the traditional binary classification that neutrality law relies upon.[211] Numerous commercial actors have both civilian and military implications in warfare. For instance, drone manufacturers contribute to both civilian applications like surveillance and military uses for reconnaissance and targeted strikes. Similarly, companies involved in the production and supply of dual-use technologies, such as telecommunications equipment or advanced computing systems, serve both civilian and military markets. This dual-use nature of technologies and services blurs the boundaries between civilian and military domains, challenging traditional legal distinctions and posing regulatory complexities.

[209] Eytan Tepper, "The Laws of Space Warfare: A Tale of Nonbinding International Agreements" (2023) Maryland Law Review 1 at 28 (SSRN).

[210] Stephens, *supra* note 18 at 76.

[211] Guoyu Wang, "The complex neutrality of commercial space actors in armed conflict", (24 November 2023) at para 7, online: *Humanitarian Law & Policy Blog* <https://blogs.icrc.org/law-and-policy/2023/11/16/the-complex-neutrality-of-commercial-space-actors-in-armed-conflict/>.

3.2.1 Regulating Dual-Use Dilemmas

The Outer Space Treaty,[212] along with its counterparts, forms the foundation of space law.[213] The treaties, developed under the auspices of the United Nations, encompass The Rescue Agreement,[214] The Liability Convention,[215] The Registration Convention,[216] and The Moon Agreement.[217]

However, OST is the cornerstone agreement that places a strong emphasis on allocating space for peaceful uses but makes no special provisions for dealing with security issues pertaining to dual-use assets.[218] Although international law, including the UN Charter, is incorporated into Article III of the OST, its general principles might not be sufficient to adequately regulate the intricacies inherent in dual-use goods.[219]

OST highlights challenges in regulating military operations in space, expressing uncertainties in interpreting "peaceful purposes", despite recognizing broad principles of international law

[212] Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, 27 January 1967 18 U.S.T. 2410 610 U.N.T.S. 205, 61 I.L.M. 386 (entered into force 10 October 1967).

[213] Ram Jakhu & Steven Freeland, *The Relationship Between the Outer Space Treaty and Customary International Law,* 1st ed. (International Astronautical Federation, 2016) at 32.

[214] Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space, 19 December 1967 (entered into force 3 December 1968).

[215] Convention on International Liability for Damage Caused by Space Objects, 29 March 1972 A/AC.105/C.2/10 (entered into force 1 September 1972).

[216] Convention on Registration of Objects Launched into Outer Space, 12 November 1974 (entered into force 15 September 1976).

[217] Agreement Governing the Activities of States on the Moon and Other Celestial Bodies, 18 December 1979 (entered into force 11 July 1984).

[218] Richa Maria & Shagnik Mukherjea, "International Humanitarian Law and its Application to Armed Conflicts in Outer Space", (5 September 2023) at para 4, online: *RGNUL Student Research Review* <https://www.rsrr.in/post/international-humanitarian-law-and-its-application-to-armed-conflicts-in-outer-space>.

[219] *Ibid* at para 6.

such as UN Charter itself,[220] and addressing the dual-use phenomenon, as certain conventional weapons are not explicitly prohibited, raising concerns over potential misinterpretations.[221]

The UN Charter, particularly Article 2(4), on the other hand, unequivocally prohibits the use of force, extending its application to outer space.[222] The UN Charter's general principles and language which particularly addresses the prohibition of the use of force seems to allow for its broad application to space conflicts.[223] Article 2(4) of the UN Charter states that "*All Members shall refrain in their international relations from the threat or use of force against the territorial integrity or political independence of any state.*" Since the language of the charter does not restrict the prohibition to any particular area, it can be interpreted broadly to even cover activity in outer space.[224] The charter's overarching goal of maintaining international peace and security is understood to apply to emerging domains like outer space, reflecting its adaptability to evolving global challenges.[225]

The UN Charter's focus on international peace and security lacks clear guidelines for dual-use challenges, leading to varied interpretations and persistent disagreements on applying IHL principles to space systems. This exacerbates concerns over dual-use object misuse, highlighting ongoing complexities in space legal frameworks.[226]

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[220] Richard Morgan, "Military Use of Commercial Communication Satellites: A New Look at the Outer Space Treaty and Peaceful Purposes" (1994) 60:1 J. Air L. & Com. 237 at 241.

[221] *Ibid* at 242.

[222] Ruys, *supra* note 208 at 162.

[223] Jackson Nyamuya Maogoto, and Steven Freeland, "Space Weaponization and the United Nations Charter Regime on Force: A Thick Legal Fog or a Receding Mist?" (2007) 41: 4 The Int'l Lawyer 1091 at 1096 (JSTOR).

[224] *Ibid* at 1093.

[225] Muggi Tuvdendarjaa, "Challenges of the United Nations Peacekeeping Operations" (2022) 23 Security Nexus 1 at 2.

[226] Stephens, Steer, *supra* note 67 at 82.

The definition of "peaceful purposes" within the framework of space law faces a critical challenge due to the dual-use nature of satellites. This becomes especially pronounced when a satellite initially designed for civilian purposes unexpectedly transitions to a military role. The inherent ambiguity in distinguishing between civilian and military functions introduces uncertainties into the classification and regulation of space assets. The fluid nature of technology and strategic considerations means that the true nature and potential use of satellites can evolve over time, rendering the initial classification uncertain. As a result, crafting a definition that adequately addresses these dynamic shifts and potential misuses poses a formidable challenge for policymakers and space law practitioners, emphasizing the need for a nuanced and adaptive approach to the concept of "peaceful purposes" in the context of evolving dual-use technologies.

3.2.2 International Humanitarian Law in Space Warfare

Applying IHL to space warfare hinges on establishing whether the circumstances qualify as an international armed conflict (IAC) or non-international armed conflict (NIAC), as opposed to being dependent on the legality of the choice to use force.[227] Article III of the OST, which is a reflection of customary law and requires the use of space "in accordance with international law," which includes IHL, emphasizes this.[228]

In its 1986 Nuclear Weapons Advisory Opinion, the International Court of Justice (ICJ) unambiguously confirmed that IHL applies to "all forms of warfare and to all kinds of weapons," without making any distinctions based on the realm of battle or the tactics used.[229] The foundation of the LOAC in space operations is distinction, proportionality, eliminating

[227] Fernandez*, supra* note 105 at 254.

[228] Maria & Mukherjea, *supra* note 218 at para 6.

[229] *Legality of the Threat or Use of Nuclear Weapons*, (1996) ICJ Reports 1996 at para 226.

needless suffering, and military necessity, which are the four guiding principles of IHL.[230] The assertion that IHL directly applies to armed conflicts in space gains strong support from the 2019 Challenges Report by the International Committee of the Red Cross (ICRC).[231] This influential document cogently underscores the imperative connection between IHL and conflicts in the space domain, reinforcing the argument for the direct and pertinent application of established humanitarian principles to address the distinctive challenges posed by space warfare. However, the question of whether space operations alone can start a state of armed conflict presents a more complex challenge, even while it is undeniably true that IHL applies to space operations during armed conflicts that are sparked by terrestrial military force.

3.2.3 "Attack" Conundrum: Dual-Use Implications

In the framework of IHL, the term "attack" is a crucial factor that determines the application of distinct legal principles. Regulations, including those that forbid "attacks" on civilian targets and mandate proportionality in all "attacks," are based on the definition provided in Additional Protocol I's Article 49(1).[232] An "*act of violence against the adversary, whether in offense or in defence*" constitutes an attack, underscoring the significance of this conceptual fulcrum.[233]

The dual-use phenomenon further complicates matters for this definition as well. Considerations arise in scenarios such as the self-destruction of one's satellite during armed

[230] "International Rules and Norms: Constraints on Space Operations" (March 2018) online: *A Virtual Think Tank (ViTTa)*® <https://apps.dtic.mil/sti/pdfs/AD1095120.pdf> at 17.

[231] *ICRC report on International Humanitarian Law and the Challenges of Contemporary Armed Conflicts – Recommitting To Protection In Armed Conflict On The 70th Anniversary Of The Geneva Conventions*, ref. 4427 (International Committee of the Red Cross, 2019) at 13 (www.icrc.org).

[232] Russell Buchan, "Cyber Warfare and the Status of Anonymous under International Humanitarian Law" (2016) 15:4 Chinese Journal of International Law 741 at 759.

[233] "Fundamentals of IHL How does law protect in war?", (2023) at 28, online (pdf): *Online Casebook-ICRC* <https://casebook.icrc.org/law/fundamentals-ihl>.

conflict, where the act alone may not constitute an attack.[234] On the other hand, the operation becomes an attack covered by IHL regulations if it is intended to produce orbital debris that would destroy hostile satellites.[235] Similarly, regional denial of the GPS signal raises questions about the nature of attacks when service providers are military entities, and the potential fallout affects both military and civilian systems.[236]

Understanding the implications of humanitarian law for less technologically advanced states during armed conflict in space is crucial, as is the complex interaction between the dual-use nature of space technologies and the meaning of "attack" in space operations.[237] The definition of an "attack" becomes a crucial aspect in deciding how well IHL manages space conflicts and deals with the intricacies of the dual-use phenomenon.[238]

Moreover, less technologically advanced states in space conflicts face challenges like vulnerable defences, limited space awareness, dependence on space assets, and legal interpretation difficulties. These disparities impact global power dynamics, resource allocation, and open opportunities for international collaboration. Enforcement difficulties further hinder effective protection of civilians. Addressing these issues necessitates a careful and nuanced approach to ensure the application of humanitarian principles in the distinctive context of space

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[234] Pražák, "Dual-use conundrum", *supra* note 2 at 402.

[235] Cassandra Steer, "Global Commons, Cosmic Commons: Implications of Military and Security Uses of Outer Space" (2017) 18:1 Geo J Int'l Aff 9 at 12.

[236] Colin Wall & Wegge Njord, "The Russian Arctic Threat: Consequences of the Ukraine War", (25 January 2023) at para 29, online: *Center for Strategic and International Studies* <https://www.csis.org/analysis/russian-arctic-threat-consequences-ukraine-war>.

[237] Jane Vaynman & Tristan A Volpe, "Dual Use Deception: How Technology Shapes Cooperation in International Relations" (2023) 77:3 International Organization 599 at 612.

[238] Knut Dörmann, Tilman Rodenhäuser, Laurent Gisel, "Twenty Years on: International humanitarian law and the protection of civilians against the effects of cyber operations during armed conflicts", (March 2021) at 28, online (pdf): *International Review of Red Cross* <https://international-review.icrc.org/sites/default/files/reviews-pdf/2021-03/twenty-years-ihl-effects-of-cyber-operations-during-armed-conflicts-913.pdf>.

conflicts. In light of these challenges, there is a pressing need for a re-evaluation and potentially a redefinition of the term "attack" in the context of space warfare. It should account for the dual-use nature of space assets, considering both intentional and unintentional actions that could lead to detrimental consequences in the space environment.

3.2.4 Dual-Use Complexities: Distinction Principle

The fundamental tenet of IHL is distinction, which requires that, in times of armed conflict, combatants, civilians, military objectives, and civilian objects be clearly distinguished from one another. This is reflected in Additional Protocol I (AP I) Articles 48, 51, and 52,[239] which represents customary international law and acts as a fundamental framework for judging whether an attack is lawful.[240]

In accordance with customary law, Article 52(2) of Additional Protocol I (AP I) stipulate that targeting an object is permissible only if its destruction offers a discernible military advantage.[241] This complicates delineating what qualifies as a military objective. The common practice of employing civilian launch systems for military satellites in space warfare exemplifies a straightforward scenario where both the civilian launch system and the military satellite become legitimate targets during hostilities.[242]

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[239] Protocol Additional to the Geneva Conventions of 12 August 1949, and relating to the Protection of Victims of International Armed Conflicts (Protocol 1), 8 June 1977, 1125 UNTS 3, 1991 ATS No 29/16 ILM 1391 (1977) (entered into force 7 December 1978) [Additional Protocol I or API].

[240] Fausto Pocar, "The Additional Protocols 40 Years Later: New Conflicts, New Actors, New Perspectives", (7 September 2017) at 85, online: *International Institute of Humanitarian Law* <https://iihl.org/wp-content/uploads/2018/06/The-Additional-Protocols-40-Years-Later-New-Conflicts-New-Actors-New-Perspectives.pdf>.

[241] *Ibid* at 87.

[242] Yun Zhao & Shengli Jiang, "Armed Conflict in Outer Space: Legal Concept, Practice and Future Regulatory Regime" (2019) 48 Space Policy 50 at 54.

While the language of Article 52(2) seems straightforward, its application in the context of space introduces nuances resonating with the broader dual-use dilemma in space warfare. Achieving a balance between the principle of distinction and the intricacies of dual use in space technologies underscores the requirement for a nuanced understanding of IHL principles to address the evolving landscape of armed conflict beyond Earth.

However, an alternative approach, aligned with the principle of distinction advocates, treating civilian payloads as separate objects, necessitating efforts to minimize harm and considering any damage as "collateral damage."[243] However, this method raises the possibility of excess harm, which might outright forbid attacks on the satellite even in the event that a military payload is hosted on it.[244]

In the context of a dual-use satellite, wherein both civilian and military elements coexist, designating the satellite bus as a military target underscores the integrated character of the entire system. While a military payload constitutes a distinct military objective, the satellite bus, serving as the comprehensive structure enabling both civilian and military functions, also qualifies as a legitimate military target. This accentuates the intricacies of target selection in space warfare and underscores the difficulties posed by the dual-use nature of such assets, particularly in the application of the principle of distinction in IHL.

[243] Janina Dill, "What is the Role of International Law in Preventing the Use of Nuclear Weapons, Specifically by Russia Against Ukraine? Penn Global", (19 July 2023) at para 7, online: *Perry World House* <https://global.upenn.edu/perryworldhouse/news/what-role-international-law-preventing-use-nuclear-weapons-specifically-russia>.

[244] Michael Schmitt and Sqn Ldr Kieran Tinkler. "War in space and international humanitarian law", (14 July 2022) at para 22, online: *Just Security* <https://www.justsecurity.org/68906/war-in-space-how-international-humanitarian-law-might-apply/>.

3.2.5 Dual-Use Complexities: Proportionality Principle

The principle of proportionality is articulated in Additional Protocol I (AP I) Article 51(5)(b), this principle bars parties engaged in armed conflicts from launching attacks expected to cause disproportionate harm to civilians, civilian objects, or both, in relation to the anticipated military advantage.[245] In the intricate landscape of space warfare, where dual-use technologies blur the lines between civilian and military applications, adherence to the principle of proportionality becomes essential to minimize collateral damage and uphold humanitarian standards.[246]

The principle of proportionality is crucial in the context of space conflicts due to its role in preventing excessive harm to civilians and civilian objects. It prohibits parties involved in a conflict from initiating attacks that are expected to cause disproportionate damage to civilians or civilian infrastructure compared to the anticipated military advantage.[247] The complexity arises when assessing attacks on dual-use space systems that serve both military and civilian functions. Evaluating proportionality becomes challenging, particularly in scenarios where a space system providing critical services, such as positioning, navigation, and timing, is the target. The heightened difficulty in proportionality evaluation is exemplified when considering the potential cascade effects, including aviation incidents, road accidents, and disruptions in international financial markets, resulting from the targeting of such systems.[248]

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[245] Anaïs Maroonian, "Proportionality in international humanitarian law: A principle and a rule", (20 March 2023) at para 19, online: *Lieber Institute West Point* <https://lieber.westpoint.edu/proportionality-international-humanitarian-law-principle-rule/>.

[246] Pražák, "Dual-use conundrum", *supra* note 2 at 399.

[247] Bruce Cronin, "Reckless Endangerment Warfare: Civilian Casualties and the Collateral Damage Exception in International Humanitarian Law" (2013) 50:2 J. Peace Res. 175 at 179.

[248] Irina Chernykh & Daniil Volodin, "The Principle of International Cooperation and Sharing of Information Principle under International Space Law: Towards Synergy" (2023) at para 16, online: *Space Policy* <https://www.sciencedirect.com/science/article/pii/S0265964623000607>.

Furthermore, the principle of proportionality extends its relevance to the domain of space debris, an inevitable consequence of destructive attacks on space objects. Attacks, particularly those generating significant debris, pose enduring hazards to the space environment. Additionally, the principle of proportionality gains added significance concerning space debris, akin to the understanding that environmental harm on Earth is regarded as a facet of civilian harm in proportionality assessment.[249]

Articles 35(3) and 55(1) of Additional Protocol I stress the duty to prevent extensive harm to the environment during armed conflict. Customary IHL Rules 43, 44, and 45 further support this, reflecting an obligation to avert environmental damage.[250] Convention on the Prohibition of Military or Any Other Hostile Use of Environmental Modification Techniques, through Articles I and II, contributes to protecting the environment from intentional military modification[251] and the precautionary principle in IHL emphasizes minimizing environmental harm, ensuring a thorough consideration of environmental impacts in armed conflicts beyond Earth.[252]

Furthermore, civilian objects, once employed for military purposes, shed their protected status, transforming into military objectives—commonly termed dual-use objects.[253] The quandary of

[249] Joseph S. Imburgia, "Space Debris and Its Threat to National Security" (2011) 44: 3 Vanderbilt J. Transnat'l L. 589 at 594.

[250] Maroonian, *supra* note 245 at para 24.

[251] Convention on the prohibition of military or any other hostile use of environmental modification techniques, 10 December 1976 C.N.263.1978 (entered into force 5 October 1978).

[252] Olavo de O Bittencourt Neto, "Preserving the outer space environment: The 'precautionary principle' approach to space debris" (2013) 14 Proceedings of the International Astronautical Congress, IAC 11213–11223 at 342.

[253] Michael N Schmitt, "Targeting Dual-Use Structures: An Alternative Interpretation", (28 June 2021) at para 11, online: *Lieber Institute West Point* <https://lieber.westpoint.edu/targeting-dual-use-structures-alternative/>.

dual-use presents significant humanitarian issues, as ICRC skilfully conveyed in its concerns regarding the possible consequences of targeting such integrated systems.[254]

In examining this issue, the Group of Governmental Experts on Further Practical Measures for the Prevention of an Arms Race in Outer Space emphasized possible outcomes like the breakdown of communication networks, harm to Earthly health systems, hampered attempts to prevent and mitigate disasters, and compromised navigational systems.[255] Amidst these challenges, the principle of proportionality emerges as a guiding tenet.[256]

Since according to Rule 14 of the ICRC's Customary IHL study, attacks that inflict disproportionately large harm on civilians relative to the expected military advantage are expressly forbidden. This standard demands careful analysis, with the assaulting side comparing the anticipated direct military advantage for each strike to the civilian casualties.[257]

It is evident that proportionality in space conflict faces formidable challenges. Ambiguities in defining military advantage, the absence of clear metrics, technological limitations, and the lack of historical precedents make precise assessments complex. Additionally, global collaboration is hindered by geopolitical tensions. Overcoming these barriers is crucial to developing a framework that ensures the proportional application of force while upholding humanitarian principles in the unique context of space warfare.

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[254] International Committee of the Red Cross (ICRC) position on autonomous weapon systems: ICRC position and background paper, IRRC No. 915 (January 2022) at para 48, online: *International Committee of the Red Cross (ICRC)* <https://international-review.icrc.org/articles/icrc-position-on-autonomous-weapon-systems-icrc-position-and-background-paper-915>.

[255] Schmitt, "Targeting Dual-Use Structures", *supra* note 253 at para 12.

[256] Persoz, *supra* note 50 at 74.

[257] Gilles Carbonnier, *The critical importance of neutrality: A humanitarian perspective into a multipolar world* (2023) at 13, online (pdf): *International Committee of the Red Cross* <https://www.icrc.org/en/document/critical-importance-neutrality-humanitarian-perspective-multipolar-world>.

Furthermore, the scrutiny and contention surrounding the adequacy of the proportionality principle in protecting victims of aggression from dual-use assets in space warfare also stems from the inherent challenges posed by the dual-use dilemma. The complexity arises because dual-use satellites, themselves, can be utilized for various functions, including communication, navigation, Earth observation, and military surveillance. The difficulty lies in determining whether a particular dual-use satellite is primarily serving civilian or military objectives at any given moment. This ambiguity, thus, creates a significant obstacle when applying the proportionality principle, which requires a clear assessment of the expected military advantage compared to the potential harm to civilians or civilian infrastructure.

3.2.6 Dual-Use Complexities: Precautionary Measures

A fundamental pillar of IHL, the principle of precaution meticulously guides the conduct of all parties engaged in armed conflict, demanding meticulous attention to avert or minimize inadvertent harm to civilians and civilian property. The observance of precautions assumes heightened significance in the realm of space warfare, given the distinctive challenges posed by the dual-use nature of space technologies.[258]

This principle of precaution, as outlined in Article 57(1) of Additional Protocol I, requires continuous vigilance to protect civilians and their property both before and during an attack. The core principle of precaution imposes an obligation to carefully choose methods and means of warfare, including tactics and weapons, with the explicit goal of preventing and, at the very least, minimizing incidental harm to civilian life, injuries to civilians, and damage to civilian objects. In situations where multiple military objectives promise a similar military advantage,

[258] Cassandra Steer & Dale Stephens, "International Humanitarian Law and Its Application in Outer Space" in Cassandra Steer & Matthew Hersch, *War and Peace in Outer Space: Law, Policy, and Ethics,* 1st ed. (Oxford University Press, 2020) at 103.

the principle dictates the selection of the objective anticipated to pose the least danger to civilian lives and civilian property.[259] This obligation encompasses strategic and tactical decision-making in conflict, impact assessment of an attack, and target selection in case of space warfare. Crucially, when determining the targetable portion of a dual-use space object to minimize harm to civilian features, preference must be accorded to practical tools and tactics that solely impact military components.[260]

Furthermore, the imperative to assess and mitigate space debris resulting from an attack also aligns with the precautionary principle. Article IX of the Outer Space Treaty, emphasizing "principle of due regard" as articulated in the first sentence of Article IX, which states: "*In the exploration and use of outer space, including the Moon and other celestial bodies, States Parties to the Treaty shall conduct all their activities in outer space, including the Moon and other celestial bodies, with due regard to the corresponding interests of all other States Parties to the Treaty*." This principle accentuates the need for a delicate balance between state interests and consequences for other neutral states.[261] Consequently, the obligation to minimize space debris creation, dovetailing with IHL's precautionary mandate, underscores the necessity for a thoughtful analysis of attack strategies.[262]

While the principle of precautions against the effects of attacks requires parties to implement feasible measures, such as relocating civilian objects from the vicinity of military objectives,

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[259] Jean Francois Queguiner, “Precautions under the law governing the conduct of hostilities”, (December 2006) 795, online (pdf): *International Review of the Red Cross* <https://www.icrc.org/en/doc/assets/files/other/irrc_864_queguiner.pdf>.

[260] Abdul Rehman Khan, “Space Wars: Dual-Use Satellites” (2017) 14:3 Rutgers Journal of Law & Public Policy 314 at 323.

[261] Bohdan*, supra* note 147 at 528.

[262] Roman Reyhani, "Protection of the Environment During Armed Conflict" (2006) 14: 2 Mo. Envtl. L. & Pol'y Rev. 323 at 325.

the application of these principles becomes intricate in navigating the intricate dual-use landscape.

3.3 Challenges to Law of Neutrality in the Space Domain

The Hague Conventions provide expression to the idea of neutrality, which originated from a state's desire to stay out of external conflicts.[263] These agreements set forth rights and obligations during wars on Earth, with a focus on neutral state territory defense and impartiality. Although these rules have historically governed conflicts on Earth, it is unclear how these concepts should be applied to space, particularly when armed spacecraft launch from or pass through neutral territory.[264]

In accordance with Article VI of OST, a state is internationally liable for "*national activities in outer space*," whether they are carried out by governmental or non-governmental organizations.[265] Interestingly, space law does not classify independent "private space activities as national space activities of their respective states.[266] However, the inherent duality of numerous space objects, serving purposes in both civilian and military domains, exacerbates the challenges associated with identifying responsibilities and consequences.[267] As technology advances, an increasing number of satellites, space probes, and other objects are designed to

[263] Wolff Heintschel von Heinegg, "Neutrality in the war against Ukraine", (20 March 2023) at para 6-7, online: *Lieber Institute West Point* <https://lieber.westpoint.edu/neutrality-in-the-war-against-ukraine/>.

[264] Wang, *supra note* 211 at para 8.

[265] Todd Harrison, *International Perspectives on Space Weapons* (Center for Strategic & International Studies, 2020) at 7 (www.csis.org).

[266] Anastasia Voronina, "The How's and Why's of International Cooperation in Outer Space: International Legal Forms of Cooperation of States in Exploration and Use of Outer Space" (2016) Theses, Dissertations, and Student Research in Space, Cyber, and Telecommunications Law, University of Nebraska 1 at 29 (Digital Commons@ University of Nebraska).

[267] S Macdonald & B Birdi, "The concept of neutrality: a new approach" (2020) 76:1 Journal of Documentation 333 at 342.

fulfil both civilian and military functions.[268] The sheer quantity and diversity of these dual-use space objects contribute to the complexity of managing their activities and discerning the intent behind their deployment.

A pivotal factor in this analysis is the issue of attribution, demanding a meticulous case-by-case examination of the support provided by a neutral state to commercial space actors engaged in armed conflicts. A neutral state may be seen to have broken its neutral duty under the law of state responsibility if there is evidence linking a commercial space actor to an armed conflict.[269] In light of the Russia-Ukraine conflict as explained below, it becomes apparent that a neutral state's potential violation of its neutrality obligations under the law of state responsibility hinges on the discernment of any evidence linking a commercial space actor to the armed conflict. The argument arises that in the absence of a clear legal framework tailored to the intricate dynamics of space warfare, the application of neutrality laws becomes an intricate puzzle, demanding meticulous scrutiny of the involvement of neutral states in supporting commercial space entities associated with armed hostilities.

The integration of commercial satellite technologies into military operations is exemplified by the British Skynet system, a privately managed satellite network operating in the military-reserved X band.[270] Originally designed for military communication, Skynet now extends its services to vital aspects of Command and Control (C2), including satellite management,

[268] Ankita Kamath, "The Application of the Traditional Concept of Neutrality to Modern Means of Warfare" (November 2021) at para 11, online: *The Yale Review of International Studies* <http://yris.yira.org/essays/5466>.

[269] Wang, *supra note* 211 at para 14.

[270] "Skynet 5 military communications satellite system", (18 February 2020) at para 15, online: *Airforce Technology* <https://www.airforce-technology.com/projects/skynet-5-military-communications-satellite-system/>.

telecommunications, and data storage.[271] This shift introduces new dynamics, where commercial systems and their civilian users become potential targets, emphasizing the intricate and evolving nature of modern warfare.[272] In conflict zones like Ukraine, commercial satellite technology, exemplified by SpaceX's Starlink, is increasingly integrated into military operations. Originally designed for broadband internet access, Starlink has evolved into a vital component supporting Ukrainian forces in tactical military operations, including unmanned aerial vehicle (UAV) use and communication equipment.[273] This dual-use capability extends to both civilian and military users, connecting them to software-driven technologies. However, challenges arise from this integration, as demonstrated by the March 2022 "jamming" incident, highlighting security concerns associated with using commercial space assets in military contexts.[274]

Crucially, neutrality law prohibits neutral states from providing ammunition or war material to belligerents.[275] However, a crucial distinction arises in the context of private companies, as treaty law does not mandate neutral states to prevent such entities from selling munitions and war material. Traditional neutrality law draws a line between unlawful assistance by the neutral state and lawful activities by private entities within a neutral state.[276] The challenge intensifies

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[271] Laetitia Cesari, "Commercial space operators on the Digital Battlefield", (30 January 2023) at para 6, online: *Centre for International Governance Innovation* <https://www.cigionline.org/articles/commercial-space-operators-on-the-digital-battlefield/>.

[272] "How Elon Musk's satellites have saved Ukraine and changed warfare", (5 January 2023) at para 4, online: *The Economist* <https://www.economist.com/briefing/2023/01/05/how-elon-musks-satellites-have-saved-ukraine-and-changed-warfare>.

[273] Bryan Bender, Christopher Miller & Mark Scott, "UkraineX: How Elon musk's space satellites changed the war on the ground", (8 Jun 2022) at para 3, online: *POLITICO* <https://www.politico.com/news/2022/06/09/elon-musk-spacex-starlink-ukraine-00038039>.

[274] Cesari, *supra* note 271 at para 5.

[275] George Walker, "Information Warfare and Neutrality" (2000) 33:5 Vand. J. Transnat'l L. 1079 at 1113.

[276] Hitoshi Nasu, "The Future Law of Neutrality", (19 July 2022) at para 3, online: *Lieber Institute West Point* <https://lieber.westpoint.edu/future-law-of-neutrality/>.

when evaluating whether military telecommunication or remote sensing services provided to a belligerent constitute "war materials" or fall under the purview of "export" or "transit." This underscores a key loophole in space assistance, where an American company, initially privately funded, now holds a state contract to provide the same services in support of Ukraine's war against Russia.[277]

Despite these legal frameworks, the application of neutrality law to space warfare encounters limitations. The dynamic and interconnected nature of space activities, often involving numerous private entities operating within neutral states, defies traditional neutrality paradigms.[278] The attribution of a private company's actions to a neutral state requires a thorough understanding of the specific circumstances, making case-by-case analyses challenging in the rapidly evolving space domain.[279]

In the context of the Russia-Ukraine conflict, the nuanced debate on neutrality's relationship with the prohibition of aggression unfolds complexities that extend to various aspects, including the supply of arms.[280] The European Union (EU) and neutral states like Ireland and Austria grapple with decisions regarding the nature of support they provide to Ukraine.[281] The

[277] Alex Marquardt, "Musk's SpaceX says it can no longer pay for critical satellite services in Ukraine, asks Pentagon to pick up the tab", (14 October 2022) at para 4, online: *CNN* <https://www.cnn.com/2022/10/13/politics/elon-musk-spacex-starlink-ukraine/index.html>.

[278] Noëlle van der Waag-Cowling, "Stepping into the breach: military responses to global cyber insecurity", (17 June 2021) at para 7, online: *Humanitarian Law & Policy Blog* <https://blogs.icrc.org/law-and-policy/2021/06/17/military-cyber-insecurity/>.

[279] Michael Spies, "A human-centred approach to outer space security: how to boost UN efforts in the near-term", (9 November 2023) at para 14, online: *Humanitarian Law & Policy Blog* <https://blogs.icrc.org/law-and-policy/2023/11/09/human-centered-approach-to-outer-space-security-how-to-boost-un-efforts/>.

[280] Pearce Clancy, "Neutral arms transfers and the Russian invasion of Ukraine" (2023) 72:2 Int'l & Comp.L.Q. 527 at 534.

[281] Calin Trenkov Wermuth & Jacob Zack, "Ukraine: The EU's unprecedented provision of lethal aid is a good first step", (12 June 2023) at para 6, online: *United States Institute of Peace* <https://www.usip.org/publications/2022/10/ukraine-eus-unprecedented-provision-lethal-aid-good-first-step>.

US, UK and EU's unprecedented allocation of billions for lethal military equipment to the Ukrainian Armed Forces is considered a 'watershed' moment, diverging from the traditionally non-lethal stance of neutral states like Ireland and Austria.[282]

This situation mirrors the broader legal debate on neutrality, furthermore, the concept of collective self-defense is also brought into question, with the argument that the mere supply of arms to Ukraine, even for the express purpose of repelling Russian aggression, does not constitute the use of force in collective self-defense. While there might be a general duty to cooperate in ending the Russian invasion, it does not necessarily translate into a specific obligation to supply arms, allowing neutral states the freedom to choose measures within the law of neutrality, such as political condemnation.[283]

Furthermore, the complex dynamics of space warfare introduce a significant challenge to traditional legal frameworks, particularly the binary nature of the law of neutrality, where a state is designated as either belligerent or neutral.[284] Determining when a state's assistance becomes sufficiently connected to a belligerent's conflict operations, leading to a shift from neutrality to belligerency, lacks specific rules in the context of space scenarios. Examining the legal consequences of neutrality violations involves considering two crucial factors: the impact of commercial space actors' involvement in armed conflicts and the establishment of

[282] "Military assistance to Ukraine since the Russian invasion", online: *House of Commons Library* <https://commonslibrary.parliament.uk/research-briefings/cbp-9477/>.

[283] Keran Zhao & Xiao Fengcheng, "Aggression and determination two basic issues of international law in the Russia-Ukraine conflict", (25 April 2022) at 2, online: *Scientific Research Publishing* <https://www.scirp.org/journal/paperinformation?paperid=117479>.

[284] Wang, *supra note* 211 at para 14.

attribution.[285] The possibility of a state becoming a co-belligerent is dependent on persistent or serious breaches of its neutrality obligations.[286]

But attribution is still a difficult problem. Article VI of the Outer Space Treaty (OST) or Article 8 of the Articles of State Responsibility for Internationally Wrongful Acts (ARSIWA)[287] do not provide a clear legal basis for attribution.[288] In the Russia-Ukraine conflict, analysing the legal implications of neutrality violations involves challenges of attribution, especially with third-party states like the US or EU aiding Ukraine. A scenario might arise where a neutral state faces allegations of violating neutrality laws due to actions by its commercial space entities supporting Ukraine against the aggressor; as is the case for SpaceX

Similarly, when considering the intersection of impartial and partial actions by neutral states in the realm of commercial space actors, the complexities persist. Determining the true impartiality of restrictions on exports or space services becomes a formidable task due to intricate relationships between entities. An additional degree of complication arises from the notion of "war materials" in relation to space conflict, necessitating a careful assessment of the nature and significance of these services in armed conflicts.[289]

Also, in case of Russia-Ukraine conflict, the intricate definition of "war materials" in space services is exemplified by satellite imagery provision. Neutral states or commercial operators,

[285] Anton O Petrov, "Non-State Actors and Law of Armed Conflict Revisited: Enforcing International Law through Domestic Engagement" (2014) 19:2 J. Confl. Secur. L. 279 at 284.

[286] Michael N Schmitt, "Providing Arms and Materiel to Ukraine: Neutrality, Co-belligerency, and the Use of Force", (7 March 2022) at para 9, online: *Lieber Institute West Point* <https://lieber.westpoint.edu/ukraine-neutrality-co-belligerency-use-of-force/>.

[287] Draft Articles on Responsibility of States for Internationally Wrongful Acts, International Law Commission, November 2001, Supplement No. 10 (A/56/10), chp.IV.E.1.

[288] Sharma & Tiwari, *supra* note 164 at 748.

[289] Clancy, *supra* note 280 at 534.

aiding Ukraine, may offer imagery for humanitarian purposes but its dual-use nature raises concerns about potential military applications, including strategic analysis and troop movements. In this specific case, determining whether satellite imagery constitutes "war materials" necessitates a nuanced evaluation. The same information that aids in humanitarian relief might concurrently contribute to the military strategies of the conflict parties. This illustrates the intricate challenges in categorizing space services during armed conflicts and underscores the need for a careful examination of the dual-use potential of technologies involved in the Russia-Ukraine war.

3.3.1 Self-Defense and "Qualified Neutrality" in Space

The principles of self-defense, deeply rooted in international law, provide crucial guidance for navigating the legal terrain of operations in space[290], especially when grappling with the challenges of dual-use technologies. International law, notably Article 2(4) of the UN Charter, clearly forbids the use of force between states without consent. However, consent and self-defense may justify such actions.[291]

When a state's territory is under armed attack, the restriction in Article 2(4) may be waived either by self-defense or with the authorisation of the Security Council under Chapter VII. [292] A State may use force in response to an armed attack or an immediate threat in accordance with the guidelines set forth in Article 51 of the UN Charter.

[290] Jack Mawdsley, "Applying Core Principles of International Humanitarian Law to Military Operations in Space" (2020) 25:2 J. Confl. Secur. L. 263 at 268.

[291] Zhao and Jiang, *supra* note 242 at para 4.

[292] Chris O'Meara, "Reconceptualising the right of self-defence against 'imminent' armed attacks" (2022) 9:2 J. Use Force Int. Law 278 at 289.

Embedded within the framework of international law, UN Charter Article 103 establishes a hierarchy for international agreements, prioritizing obligations of UN member states. This hierarchy gains significance in navigating the complexities of space warfare and dual-use scenarios.[293] Anchored in this legal framework is Outer Space Treaty (OST) Article III, mandating adherence to international law, including the UN Charter, in all space activities. This connection extends broader legal principles, like laws of armed conflict and UN Charter Article 2(4) prohibiting the threat or use of force, to state activities in space.[294]

However, it is crucial to understand how Article III and the UN Charter's right to self-defense relate to one another. States have the right to use space for self-defense, as guaranteed by Article 51 of the UN Charter.[295] Scholars disagree on whether Article III means a general extension of all international law to space or just the extension of pertinent principles, such as the UN Charter. The interpretation of Article III is still up for debate.[296] The debate over Article III of the OST also revolves around its language, stating that space activities should align with "international law, including the Charter of the United Nations." Some scholars argue this implies a broad extension of all international law to space, while others suggest a more selective application, focusing on principles directly pertinent to space activities. The crux of the debate lies in striking a balance to ensure responsible use of outer space without imposing overly restrictive regulations that could impede scientific exploration and technological progress.

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[293] Voronina, *supra* note 266 at 15.

[294] Claus Kress, "On the Principle of Non-Use of Force in Current International Law", (30 September 2019) at para 14, online: *Just Security* <https://www.justsecurity.org/66372/on-the-principle-of-non-use-of-force-in-current-international-law/>.

[295] James Moltz, *The Politics of Space Security: Strategic Restraint and the Pursuit of National Interests*, 2nd ed (Stanford University Press, 2011) at 38.

[296] Juan Felipe Idrovo Romo, "Armed Conflicts in Outer Space: Applicability and Challenges of International Humanitarian Law" (2020) 7:1 USFQ Law Review 335 at 343.

Complications arise because customary international law norms pertaining to self-defense are dynamic in nature, especially when it comes to anticipatory or collected self-defense.[297]

The resolutions passed by the United Nations General Assembly (UNGA) regarding the conflict in Ukraine indicate a widespread international denouncement of Russian aggression. Despite this, the resolutions refrain from explicitly recommending member states to provide military support to Ukraine.[298] The military assistance extended during the Ukraine war, coupled with the reactions of third-party states to this support, points towards the emergence of a concept termed "qualified neutrality" within the framework of international law. Notably, this concept appears to be contingent on specific conditions, primarily when the aggressor state hinders the United Nations Security Council (UNSC) from functioning as intended, as observed in the Russian attack on Ukraine. The circumstances surrounding the war in Ukraine, marked by an apparent act of aggression lacking justification and an overwhelming international condemnation, lay the foundation for the consideration of "qualified neutrality" as a legal position for states to adopt in similar international armed conflicts.[299]

Complications arise in customary international law norms related to self-defense, particularly in anticipatory or collective self-defense scenarios.[300] United Nations General Assembly (UNGA) resolutions on the Ukraine conflict denounce Russian aggression but refrain from explicitly recommending military support to Ukraine.[301] Therefore, the concept of "qualified

[297] Stonis, *supra* note 140 at 78.

[298] Stewart Patrick et.al. "UN Security Council Reform: What the world thinks", (28 June 2023) at para 34, online: *Carnegie Endowment for International Peace* <https://carnegieendowment.org/2023/06/28/un-security-council-reform-what-world-thinks-pub-90032>.

[299] Clancy, *supra* note 280 at 532.

[300] Stonis, *supra* note 140 at 78.

[301] Patrick, *supra* note 298 at para 34.

neutrality" emerges[302], contingent on conditions like the aggressor state hindering the United Nations Security Council (UNSC) from functioning effectively, as seen in the Russian attack on Ukraine. The aggressor state obstructing the UNSC prompts attention, and Article 51 of the UN Charter provides a legal avenue for states to autonomously contribute to collective self-defense when the UNSC fails to function effectively.[303] This utilization aligns with the concept of "qualified neutrality" in the Russia-Ukraine war, supported by various states with limited protests from third-party states, highlighting its plausibility and acceptance.

However, the inherent complexity of self-assessments by States, without authoritative involvement from the UNSC, raises concerns about potential misuse of legal solutions in future conflicts, creatin a risk of double standards.[304] States' self-restraint in presenting practices as neutral, coupled with a lack of open vindication, also poses challenges. Some States, avoiding lethal military aid, hesitate to engage in legal arguments, complicating assessment of the normative constraints imposed by the law of neutrality on their positions.

3.4 Struggles and Vulnerabilities of LTAC

As the present crisis in Ukraine demonstrates, governments with limited technological prowess face enormous hurdles in the complex convergence of space combat and dual-use technologies. Heavy dependence on commercial satellite assistance reveals weaknesses and draws attention to the shortcomings of current legal systems. IHL forbids taking aim at civilian objects in space, but because satellites are dual-purpose, there is a possibility that this prohibition will affect essential civilian services on Earth. This problem becomes much more pressing for less

[302] Clancy, *supra* note 280 at 532.

[303] Robert J. Delahunty, "Paper Charter: Self-Defense and the Failure of the United Nations Collective Security System" (2007) 56:3 Cath. U. L. Rev. 871 at 880.

[304] Clancy, *supra* note 280 at 546.

developed or technologically advanced countries, increasing the likelihood that they will be unable to properly identify and protect dual-use technologies in the increasingly contested space domain.

This exposes them to possible attacks, especially in situations when IHL is insufficient and gaps in protection are left unchecked. Though Ukraine, grappling with military inferiority, ingeniously employs homemade kamikaze drones, converting commercial UAVs into weapons with attached explosives, effectively countering Russian forces. Beyond satellite assistance, Ukraine actively sought "donations" and relied on crowdfunding to acquire military drones. This multifaceted approach underscores Ukraine's resourcefulness, utilizing both commercial satellites and repurposed technologies to level the playing field against Russia's superior military might.[305] Further reliance on private sector space capabilities underscored the importance of technological assistance in modern warfare, revealing that strategic advantages often hinge on innovative solutions from the commercial space domain.[306]

These instances underscore the vulnerability of less technologically advanced nations, such as Ukraine, which not only lack their own satellite infrastructure but also face the peril of adversaries targeting critical assets. The involvement of commercial satellite operators, like Hawkeye 360, further emphasizes the collaborative nature of space capabilities, as their data-sharing approach benefits coalition partners on the battlefield.[307] This interconnected reliance

[305] Branka Marijan, “Russia’s war on Ukraine is a test case for future conflict”, (6 October 2022) at para 13, online: *Centre for International Governance Innovation* <https://www.cigionline.org/articles/russias-war-on-ukraine-is-a-test-case-for-future-conflict/>.

[306] Marina Favaro & Heather Williams, "False Sense of Supremacy: Emerging Technologies, the War in Ukraine, and the Risk of Nuclear Escalation" (2023) 6: 1 J. Peace Nucl. Disarm. 28 at 34.

[307] Dennis M. Rice, “Deterrence and space strategy”, (December 2023) at 40, online (pdf): *AIR University* <https://www.airuniversity.af.edu/Portals/10/AUPress/Papers/SP_02_Rice_Deterrence_and_Space_Strategy.pdf >.

on satellite resources, however, accentuates the challenges faced by nations without robust space capabilities, underscoring the complex dynamics of technological dependence in modern warfare. The combination of advanced technological capabilities of developed countries, the absence of robust IHL, and the reliance on commercial satellite assistance amplifies the challenges for nations like Ukraine. The current war's space warfare dynamics underscore the urgent need for international cooperation and legal frameworks to address the complexities of space warfare and ensure the protection of less advanced nations in an increasingly interconnected space domain.

3.5 Conclusion

Delving into the intricate realm of international customary laws and a myriad of treaties becomes essential, especially considering the challenges faced by less technologically advanced states within international organizations such as the UN. Their limited influence often hampers their ability to effectively voice concerns on a global stage. This chapter, grounded in a comprehensive analysis of existing laws and treaties, intricately explores their intersection with the burgeoning challenge of space warfare, specifically the dual-use phenomenon.

The chapter meticulously navigates the intricate relationship between space warfare and the laws of armed conflict, probing the unique challenges of the evolving battlefield beyond Earth's atmosphere. The key legal principles—precaution, proportionality, and distinction—and their applicability in armed conflict is critically examined, thus advancing the position that these principles may not comprehensively address the complexities of space warfare, particularly the dual-use phenomenon. The Russia-Ukraine conflict serves as a poignant illustration, highlighting the harsh realities for less technologically advanced states in the face of vulnerabilities exposed in space warfare.

The importance of having a thorough legal framework to handle the problems posed by space warfare is emphasized in this chapter, particularly for countries with less advanced technological capabilities. The susceptibility of nations with restricted technical progress—Ukraine in the Russia-Ukraine war serves as an example of this vulnerability. In order to resolve existing difficulties, the chapter advocates for a stronger international framework and an improved legal paradigm that is tailored to the nuances of space combat. This would provide less developed nations the ability to express their concerns and pursue appropriate legal remedies on an international level.

Future research should thoroughly examine the unique legal challenges faced by less developed nations in space warfare, analysing international treaties and customary law for potential areas requiring legal mechanisms. Addressing these gaps enables the development of a more flexible legal system catering to the specific needs of nations with limited space capabilities.

In conclusion, this chapter has made an effort to offer a comprehensive analysis of the complex relationships that exist between international legal systems and the challenges posed by space warfare, particularly for nations with less developed technological infrastructure. It is essential that the international community recognize these problems going forward and make a commitment to a thorough review of legal frameworks in order to guarantee a more fair and inclusive strategy for dealing with the intricacies of space warfare on a worldwide scale.

CHAPTER IV - DUAL USE ASSETS IN SPACE

4.1 Introduction

This chapter explores the intricate concept of dual-use assets amid armed conflict in space., exploring the intersection of law, technology, and international security. Focussed on deciphering assets both civilian and military objectives purposes contemporary space endeavours, it aims to provide a comprehensive understanding by analysing them from legal, historical, and pragmatic perspectives. The chapter discusses the evolution of these assets, challenges in categorization, implications on international space law and humanitarian law, and diverse national and international perspectives. It builds upon the foundational knowledge established in the previous chapters extending the discussion from the initial space exploration to the current advancements in dual-use technology. The growing importance of these assets in contemporary space missions is emphasised thereby underscoring the need to understand their role in international law and security.

4.2 Dual-Use Assets in Space: Implications for Law

Technological advancements significantly improve the capabilities of warfare in "range, detectability, precision, or destructive power" and creates new options for such means and methods to conduct warfare.[308] Dual use refers to objects which have both civilian and military applications, creating challenges for implementing IHL principles around distinction and proportionality in targeting. Satellites represent a prime example of dual use technology which has fueled recent debate around the applicability of IHL. This concept was initially devised to demarcate the military and civilian applications of space systems and technology and has been applied to promote the effective and efficient use of outer space for both these applications.

[308] Nasu, McLaughlin, *supra note* 104 at 2.

Intrinsically, dual-use technology is not identified as a weapon.[309] Nonetheless, certain dual-use systems encompass a technology that bears the potential for misuse in the context of space weaponization.[310]

It has been acknowledged that space technology, comprising of space launch vehicles, satellites, and information technology, has bifunctional implications that could potentially be misused for malicious purposes or weaponized.[311] Nonetheless, the fact that an object is also employed for civilian purposes does not alter its identification as a military objective.[312]The principle of proportionality must be weighed, and an attack against a dual-use target is only justified as long as it does not infringe the principle of proportionality.[313]

The blurring of conceptual boundaries of weapons by the dual-use nature of space systems complicates control through conventional arms control measures and raises concerns about the potential weaponization of outer space.[314] The dependence of military forces on commercial space systems in addition with the dual use nature of many space technologies poses challenges in pinpointing military objectives and applying the principle of distinction during armed conflict in outer space.[315]

Moreover, the dual-use aspect of space systems encompasses both state and non-state actors, including the commercial sector, which may directly or indirectly contribute to space militarization and weaponization.[316] As tensions between major space powers escalate, the

[309] Pražák, "Dual-use conundrum", *supra* note 2 at 402.

[310] *Ibid* at 405.

[311] Ahmad, Naseem & Riaz, *supra* note 47 at 82.

[312] Wilson, *supra* note 159 at 825.

[313] Fernandez, *supra* note 105 at 278.

[314] *Ibid* at 280.

[315] Schmitt & Tinkler, *supra* note 244 at para 4.

[316] Jakub Pražák, "On the Threshold of Space Warfare" (2022) 20:2–3 Astropolitics 175 at 175.

likelihood of space conflict grows, necessitating the establishment of responsible behaviour and space norms to sustain peaceful utilization of outer space.[317] Hence, a deeper understanding the dual-use implications of space technology is indispensable for the development and interpretation of international space law in order to tackle the challenges and mitigate the risks associated with space conflict.

4.2.1 Evolution of Dual-Use in Space Technology

The concept of dual-use technology in space has undergone significant transformation from its historical roots to the present day, reflecting the changing nature of space technology and its diverse applications. This evolution raises crucial questions, such as the implications of the growing commercial availability of dual-use weapons on international security, and the need for a new legal and policy framework for space technology.[318]

Groundbreaking innovations such as the internet, GPS, and AI, which originated from defence projects, epitomized the dual-use characteristic of these technological breakthroughs.[319] The surge in dual-use technology marked a pivotal shift in the research and development (R&D) landscape after the Cold War.[320]

The private sector's dominance in space innovation has shifted governments to consumers rather than providers of space services.[321] This democratization poses challenges to maintaining security and safety in outer space. The widespread availability of space technology globally has shifted governments into consumers rather than exclusive providers of space

[317] Stephens, Steer, *supra* note 67 at 83.

[318] "The Rise in Dual-Use Technologies: A Paradigm Shift", (23 October 2023) at para 12, online: *Starburst* <https://starburst.aero/news/the-rise-in-dual-use-technologies/>.

[319] *Ibid* at para 11.

[320] *Ibid* at para 12.

[321] *Ibid* at para 15.

services, leading to challenges in ensuring security and safety in outer space due to its democratization.[322]

Disruptive technology start-ups like Amazon, Alphabet, and Meta have outpaced government defense departments in R&D, innovation, and deployment, causing a significant shift in innovation leadership. This change has profound implications for the development and deployment of dual-use technologies.[323]

4.2.2 Distinguishing Civilian and Military Use

The differentiation between civilian and military space assets requires determination of the intent of its use.[324] Civilian usage of space technology emphasizes on transparency, international cooperation, and the sharing of data for the greater good operating outside the exclusive control of military entities[325].

Conversely, military employment of space technology is centred on utilizing it for security and defence objectives.[326] This encompasses a range of activities such as surveillance, reconnaissance, intelligence gathering, and missile defence systems.[327] It may even extend to the development and deployment of destructive systems, including anti-satellite weaponry and satellite defences, which may disobey the principles of peaceful utilization and exploration of outer space.[328]

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[322] *Ibid* at para 15.

[323] "The Changing Landscape of Dual-Use Technology: Will Startups Make Us More Secure?", (31 May 2023) at para 3, online: *MassChallenge* <https://masschallenge.org/articles/dual-use-innovation/>.

[324] Joan Johnson-Freese, *Space Warfare in the 21st Century: Arming the Heavens*, 1st ed (London: Routledge, 2016) at 67.

[325] Wilson, *supra* note 159 at 825.

[326] *Ibid* at 824

[327] *Ibid* at 825

[328] *Ibid* at 825.

Numerous space systems are dual-use, serving both civilian/commercial and military objectives. These systems can be operated by both civilian or commercial entities and militaries, providing services across both sectors.[329] However, it is pertinent to note that dual-purpose systems are not inherently of a military nature and must fulfil non-military purposes.[330]

Understanding the dichotomy between civilian and military applications of space technology is essential to comprehending the varied roles and uses of these technologies. Illustrative examples of space technologies employed in both civilian and military contexts include:

i. Satellite Imagery: Earth observation satellites, instrumental in civilian tasks like weather forecasting, environmental studies, and disaster response, are also pivotal for military objectives such as reconnaissance, intelligence collection, and monitoring adversarial activities.[331]
ii. Global Navigation Satellite Systems (GNSS): Systems like the United States Global Positioning System (GPS) offer precise positioning and timing data for civilian uses like navigation, and concurrently serve military applications including missile guidance and tracking troop movements.[332]

[329] Ortega, "The Cyber Phantom Menace to Space Security", *supra* note 207 at para 21.

[330] Almudena Azcárate Ortega, "Not a Rose by Any Other Name: Dual-Use and Dual-Purpose Space Systems", (June 5, 2023) at para 15, online: *Lawfare* < https://www.lawfaremedia.org/article/not-a-rose-by-any-other-name-dual-use-and-dual-purpose-space-systems#:~:text=Dual%2Dpurpose%20objects%20are%20in,hostile%20actions%20against%20other%20satellites>.

[331] "Dual Dimensions: The Impact of Dual-Use Space Technologies on the Space Economy", (5 April 2023) at para 2, online: *New Space Economy* <https://newspaceeconomy.ca/2023/04/04/dual-dimensions-the-impact-of-dual-use-space-technologies-on-the-space-economy/>.

[332] *Ibid* at para 3.

iii. Communications Satellites: While these satellites facilitate civilian broadcasting, internet connectivity, and telecommunication, they are equally crucial for military forces for secure and reliable field communication.[333]

iv. Space launch vehicles Rockets designed for launching satellites for scientific research, telecommunications, and Earth observation can also be repurposed for deploying military satellites for surveillance, reconnaissance, and early warning systems, with some vehicles being adaptable for weapon delivery, such as intercontinental ballistic missiles (ICBMs).[334]

v. Remote sensing technology: Technologies like synthetic aperture radar (SAR) and multispectral imaging are employed in civilian sectors for agriculture, forestry, and geology, and are equally useful for military purposes such as detecting and monitoring military installations, tracking enemy movements, and assessing combat damage.[335]

4.2.3. Normative Status of Dual Use in IHL

In legal terms, dual use in IHL refers to objects which simultaneously meet the definition of both civilian objects and military objectives.[336] Under Article 52 of Additional Protocol I to the Geneva Conventions (API), military objectives are those objects which "make an effective contribution to military action" and offer "a definite military advantage" through their "destruction, capture or neutralization".[337] Meanwhile, Article 52 defines civilian objects as all

[333] *Ibid* at para 4.

[334] *Ibid* at para 5.

[335] *Ibid* at para 6.

[336] Hitoshi Nasu, "Targeting a Satellite: Contrasting Considerations between the Jus Ad Bellum and the Jus in Bello" (2022) 99 Int'l L Studies 6 at 7 (U.S. Naval War College Digital Commons).

[337] "Protocol Additional to the Geneva Conventions of 12 August 1949, and relating to the Protection of Victims of International Armed Conflicts (Protocol I), 8 June 1977- Commentary of 1987", online: *International Humanitarian Law Databases* <https://ihl-databases.icrc.org/en/ihl-treaties/api-1977/introduction/commentary/1987>.

objects which are not military objectives.[338] Dual use objects are those which have significant civilian uses yet also meet the criteria for military objectives.

While dual use is not explicitly addressed in API or other core IHL treaties, the concept has become widely acknowledged in state practice and IHL doctrine as an interpretive tool for applying IHL norms.[339] Specifically, dual use considerations impact assessments of the principle of distinction between civilians and combatants and between civilian objects and military objectives. Distinction is a cardinal principle of customary international law which requires that "the Parties to the conflict shall at all times distinguish between the civilian population and combatants and between civilian objects and military objectives and accordingly shall direct their operations only against military objectives". When an object has both civilian and military uses in practice, assessing its status under distinction becomes complex.[340] However, their civilian uses also demand significant weight in targeting assessments. Fundamentally, IHL requires that any expected civilian losses from an attack on a dual use object would not be "excessive" relative to the concrete and direct military advantage gained, in line with the principle of proportionality.[341] Yet there is extensive debate around interpreting key elements of this assessment.

One debate center on what civilian harms should be included in the proportionality analysis. Critics like David Koplow argue for "reverberating effects liability," considering extended consequences over time like impacts on public health when power grids or water systems are debilitated.[342] While others counter that IHL has traditionally focused on immediate civilian

[338] Nasu, "Targeting a Satellite", *supra* note 336 at 7.

[339] I. Henderson, "Proportionality under International Humanitarian Law: The 'Reasonable Military Commander' Standard and Reverberating Effects" (2021) 51:3 Vanderbilt J Transnational L 835 at 836.

[340] *Ibid* at 837.

[341] *Ibid* at 835.

[342] Nasu, "Targeting a Satellite", *supra* note 336 at 7.

losses as opposed to indirect, long-term effects.[343] There is also debate around whether hypothetical future civilian losses, if an object is debilitated and unable to provide key services at a later point, should bear on proportionality analysis.[344] These questions have significant implications for assessing satellite systems which provide wide-ranging services affecting civilian infrastructure and activities, hence assume significant importance in this analysis.

Debates on proportionality analysis considers the extent to which military forces must separate military objectives from civilian objects, in line with the precautionary obligations of distinction. Some argue separation must be pursued to the maximum extent possible[345] to enable distinction, while others contend it need only be reasonable under the circumstances.[346] The law remains unsettled regarding whether and how much states must separate military and civilian space infrastructure.

In these assessments, the normative weight falls more heavily towards protection of civilian status. Article 52(3) of API codifies the presumption of civilian status in cases of doubt.[347] State practice, UN resolutions, and scholarly analysis also emphasize the imperative to interpret distinction in a way that minimizes civilian harm, in light of IHL's overriding humanitarian purpose.[348] This suggests that when there is uncertainty regarding an object's status, it should

[343] William J. Fenrick, "International Humanitarian Law and Combat Casualities" (2005) (21:2/3) European Journal of Population 167–86 at 167 (JSTOR).

[344] Beth Van Schaack, "Evaluating Proportionality and Long-Term Civilian Harm under the Laws of War", (August 29, 2016) at para 28, online: *Just Security* <https://www.justsecurity.org/32577/evaluating-proportionality-long-term-civilian-harm-law-war/>

[345] Ori Pomson, "Civilian use of a military objective as incidental harm in a proportionality assessment?" (2022) 60(2) The Military Law and the Law of War Review 159-187 at 160.

[346] Emanuela-Chiara Gillard, "Sieges, the Law and Protecting Civilians" (27 June 2019) at para 15, online: *Chatham House* <https://www.chathamhouse.org/2019/06/sieges-law-and-protecting-civilians-0/iii-rules-international-humanitarian-law-particularly>.

[347] Nasu, "Targeting a Satellite", *supra* note 336 at 7.

[348] *Ibid* at 7.

be treated as civilian by default to preserve civilian protection. Nonetheless, debate continues around how to balance civilian protection with military necessity in targeting decisions regarding dual use objects.[349]

Access to outer space has become increasingly feasible, resulting in augmented space endeavours by both state and non-state actors.[350] The technological evolution has reduced the cost of access, rendering space activities more ubiquitous.[351] These advancements have facilitated the expansion of dual-use technologies, wherein commercial systems are now capable of fulfilling military requisites. The enhanced performance of commercial systems enables them to meet military requirements at a low cost.[352]

4.2.4 Asset Categorization Challenges: Legal Considerations

The primary obstacles in distinguishing space assets as either civilian or military stem from the dual-use nature of many such assets and the intertwined nature of military and civilian space activities. As elucidated in the preceding section, the demarcation between military and non-military uses of outer space is increasingly becoming indistinct, posing challenges in ascertaining the intended purpose of a space asset.[353] Rockets, remote sensing satellites, and navigation satellites, for instance, are all capable of serving both civilian and military functions.[354] This duality complicates the determination of the true intent and functionality of a space asset.

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[349] A Deeks, "Targeting and the Concept of Intent" (2012) 35:1 Michigan J Int'l L 79 at 79.

[350] Fernandez*, supra* note 105 at 83.

[351] Melissa de Zwart & Dale Stephens, "The Space (Innovation) Race: The Inevitable Relationship between Military Technology and Innovation" (2019) 20 Melbourne J Int'l L 1–28 at 1.

[352] *Ibid* at 837.

[353] Snyman, "Selected Legal Challenges", *supra* note 57 at 487.

[354] Mačák*, supra* note 119 at 4.

The growing dependence of military entities on civilian systems not only raises national security concerns and contractual obligations but also affects long-term political alliances and commercial sector interests.[355] The Defense Intelligence Agency's "Challenges to Security in Space 2022" report underscores the difficulties in differentiating military from civilian space services, as actions by any nation disrupting space services can affect both military and civilian assets.[356] Additionally, the fact that space objects can be registered as civilian despite being used for military purposes presents challenges in identifying and regulating military assets in space.[357] These complexities underscore the need for a comprehensive legal framework to categorize space assets effectively and ensure the peaceful use of outer space.[358]

The categorization challenges of dual-use technology carry significant legal and ethical ramifications in the realm of international space law. While international space law generally permits military uses of space, the legal and security implications arising from military and civilian reliance on identical space services are substantial.[359] The "Legality of Intermingling Military and Civilian Capabilities in Space" report contends that combining national security space functions with commercial space capabilities is justified by military necessity.[360] However, the absence of explicit prohibitions on conflict in space within international law,

[355] Michael Howard, "Rendezvous in Space: Looking in on Military Space Power" (2010) Army Space J. 1 at 16 (Defense Technical Information Center).

[356] Defense Intelligence Agency, *Challenges to Security in Space: Space Reliance in an Era of Competition and Expansion*, 2d ed (Washington, D.C.: Defense Intelligence Agency, 2022).

[357] Sharma & Tiwari, *supra* note 164 at 743.

[358] Tronchetti, *supra* note 103 at 331.

[359] Elizabeth Seebode Waldrop, *Integration of Military and Civilian Space Assets: Legal and National Security Implications* (McGill University, 2003) [unpublished].

[360] John Goehring, "The Legality of Intermingling Military and Civilian Capabilities in Space", (17 October 2022), online: *Lieber Institute West Point* <https://lieber.westpoint.edu/legality-intermingling-military-civilian-capabilities-space/>.

coupled with the growing complexity and difficulty of establishing and maintaining space control in an ever-changing environment, poses considerable ethical challenges.[361]

The dual-use nature of many space technologies blurs the conceptual boundaries of what constitutes a weapon, rendering control through hardware restrictions challenging.[362] Additionally, the lack of a universally accepted definition of "dual-use" has led to confusion among international community members, resulting in disagreements over the optimal regulation of these systems.[363] Although, IHL does not expressly define “dual-use”, an understanding of the term “use” as compared to the term “purpose” can be drawn based on the pre-existing language in the IHL in the context of targeting regulations where “use” and “purpose” are two different criteria as to the determination of an object as a military object thus making it targetable.[364] Under IHL “use” has a present function while “purpose” is used in the sense of intended future application.[365]

Therefore, the challenges in categorizing space assets as either civilian or military bear significant legal and ethical implications in international space law, necessitating careful consideration by policymakers of the potential consequences of intertwining military and civilian space activities.

4.3 Global Legal Frameworks: Dual-Use Perspectives

Understanding diverse global perspectives on dual-use in space is legally essential for space security and the global economy. It aids in identifying risks associated with space technologies,

[361] Wendy N Whitman Cobb, "Ballistic Missile Defense Effectiveness" (2020) at 4, online: *Wild Blue Yonder* <https://pubs.aip.org/aip/acp/article/748886>.

[362] New Space Economy, *supra* note 331 at para 3.

[363] *Ibid* at para 5.

[364] *Ibid* at para 5.

[365] *Ibid* at para 2.

informing policy development to prevent weaponization. Additionally, it enables a comprehensive legal analysis of existing frameworks, highlighting deficiencies requiring attention. Understanding varied perspectives promotes international cooperation, ensuring lawful and sustainable outer space utilization. Lastly, it facilitates conflict anticipation and mitigation, promoting legal stability and security in the space domain.

It is necessary to consider the intended purpose of dual-use assets as well as the historical and contextual factors when defining dual use.[366] This suggests that the categorization of dual-use is affected by the framework of values coupled with the competencies and drive of states and sub-state groups.

Moreover, the contrast between dual-use and dual-purpose systems has been put forth to differentiate between space systems that can serve both civilian and military functions and those designed specifically for both purposes.[367] This distinction was first made during the second session of the Open-Ended Working Group on Reducing Space Threats through Norms, Rules and Principles of Responsible Behaviours established under UN General Assembly resolution 76/231 and is also based on the already prevailing language of IHL.[368] This distinction is crucial as it affects the treatment and regulation of these systems. In addition, the importance of dual-use assets in the backdrop of space applications has been noted by academicians in Japan, accentuating the need to explore the Japanese approach to dual use and its effectiveness for both civil and defence purposes.[369] It is important to explore the Japanese approach because of its uniqueness and, its commitment to leverage civilian technologies for

[366] John Forge, "A Note on the Definition of 'Dual Use'" (2010) 16:1 Sci Eng Ethics 111–118 at 112.

[367] New Space Economy, *supra* note 331 at para 3.

[368] *Ibid* at para 1.

[369] Yasuo Otani et al, "Dual-Use Concept on Civil and Defense Uses of Outer Space" (2012) 10 Transactions of the Japanese Society for Artificial Intelligence, Aerospace Technology Japan Tv_1 at Tv_3 (ResearchGate).

military purposes, its new dual use space policy[370] and its active engagement in regional cooperation.[371] Furthermore, export controls on dual-use items by the European Union demonstrate its international obligations and commitments, including those associated with non-proliferation and international peace and security.[372] This showcases the influence of international agreements and regimes on the regulation and interpretation of dual-use assets. The international community is employed to establish legal and regulatory frameworks for space security, however, the confusion produced by the differences in interpretations of commonly used terminology, such as "dual-use," has the potential to result in misinterpretations and can heighten strains among states.[373] They have made efforts to protect the following namely: access to space, access to space technology and access to space services.

4.4 Conclusion

The intricate interplay between national and international perspectives on the dual nature of space assets and the evolving legal framework is important in moulding the trajectory of space exploration. The field of "dual-use" in space technology not only provides prospects for scientific progress and economic expansion globally but also has significant challenges in terms of national security and judicial oversight. Understanding the various interpretations and employment of dual-use technologies by different states is essential for establishing a steady and peaceful outer space.

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[370] Paul Kallender, *Japan's New Dual Use Space Policy. The Long Road to the 21st Century* (Asie.Visions, 2016).

[371] Ravi Amin, "China, Japan and U.S. Export Control Regulations for Dual-Use and Military Goods" (5 May 2021) at para 1-4, online: *S&P Global* <https://www.spglobal.com/marketintelligence/en/mi/research-analysis/china-japan-and-us-export-control-regulations-for-dualuse-goods.html>.

[372] "Exporting dual-use items", (26 October 2023), online: *EU Trade* <https://policy.trade.ec.europa.eu/help-exporters-and-importers/exporting-dual-use-items_en>.

[373] New Space Economy, *supra* note 331 at para 3.

The multi-purpose use of space technology comes with its attached consequences for not only legal governance but also international security and worldwide development, hence creating a need for a unified and cooperative strategy by the international community such that a clear comprehension of dual-use and its impact, fostering openness is established along with collaboration among nations. This endeavour is critical for controlling potential dangers which might occur while exploiting the full capabilities of outer space such that it benefits all of humankind while maintaining peace among the nations. There is a need to create a strong and adaptable legal framework which keeps up with the ever-advancing space sector along with international cooperation and mutual understanding, which is of great importance to navigate all the complexities that might occur hence maintaining a thriving space environment.

CHAPTER V - ARE IHL PRINCIPLES SUFFICIENT TO PROTECT LESS TECHNOLOGICALLY ADVANCED COUNTRIES (LTACs)?

5.1 Introduction

This chapter focuses on unravelling the central aim of the thesis within the context of the ongoing Russia-Ukraine conflict. Building upon the foundation laid in previous chapters, the exploration continues, delving into the question of whether IHL principles suffice to safeguard LTACs in the realm of space-based dual-use assets.

This research is centred around scrutinizing the role played by IHL principles as potential deterrents in the specific dynamics of the Ukraine-Russia conflict, where space-based dual-use assets come into play. The examination of each IHL principle unfolds against the backdrop of the current conflict, offering insights into how these principles align or diverge with the unfolding events.

The analysis begins by delving into the principles of IHL, with a specific focus on the principle of proportionality. This entails examining the application of the principle of proportionality in recent attacks on civilian infrastructure in Ukraine, encompassing both space assets and assets deployed directly from space, with a simultaneous exploration of dual-use implications. The chapter further navigates the legal implications stemming from the UN General Assembly (UNGA) condemning the Russian invasion and explores how the law of neutrality influences the actions of countries like the United States and the European Union in providing aid to Ukraine as a victim of aggression. The complexities of aid provision within the constraints of IHL principles take centre stage in this examination. Additionally, we delve into potential scenarios where Russia might target neutral assets crucial to Ukraine's defense, such as Starlink, raising critical questions about the application of IHL principles in these contexts.

Examining these challenges in the context of the Ukraine-Russia conflict not only underscores the limitations of existing IHL principles in space warfare but also emphasizes the urgent need for a more tailored legal framework that considers the unique circumstances faced by less technologically advanced nations in this evolving realm.

Therefore, as we contemplate the implications for LTACs, the discussion expands to assess whether current laws require updates to precisely mirror the realities of space warfare, particularly focusing on the implications for LTACs. This guarantees that regulations align with the intricacies and demands of contemporary space conflicts, especially those involving LTACs.

5.2 IHL Challenges in the Russia-Ukraine Space Conflict

The landscape of space warfare presents a unique challenge. The absence of explicit regulations in space warfare under international law introduces uncertainty, particularly when considering LTACs, placing them at a distinct disadvantage compared to developed nations.[374] The latter, often seen as space giants, wield significant influence in international organizations, potentially biasing decision-making.[375] Furthermore, developed nations endowed with much greater space capabilities, wields significant influence in international organizations, creating a potential bias in decision-making.[376]

[374] Michael P Gleason & Peter L Hays, "A roadmap for assessing space weapons", (October 2020) at 7, online (pdf): *Space Agenda 2021 - Center For Space Policy And Strategy* <https://aerospace.org/sites/default/files/2020-10/Gleason-Hays_SpaceWeapons_20201006_0.pdf>.

[375] James Andrew Lewis, "Technology and the shifting balance of power", (19 April 2022) at para 8, online*: Center for Strategic and International Studies* <https://www.csis.org/analysis/technology-and-shifting-balance-power>.

[376] Fernandez*, supra* note 105 at 258.

As space evolves into a strategic arena for manoeuvring, the application of established IHL principles also takes on novel dimensions and confronts fresh challenges.[377] The absence of clear regulations places LTAC entities in an ambiguous position. Facing nations with advanced space capabilities, LTACs find themselves at an undetermined and biased disadvantage. The primary predicament stems from the uncertain and inadequate legal framework governing technology-driven armed conflicts in space.[378] Furthermore, these legal restrictions impede outside interventions, restricting both assistance and damage control, making LTACs more vulnerable in the changing arena of space conflict. This imbalance underscores the pressing need for a nuanced examination of how these principles should adapt to the evolving dynamics of space warfare, ensuring a fair and equitable framework for all stakeholders.[379]

5.3 Legal and Strategic Concerns in the Russia-Ukraine Crisis

The Deputy Head of the Delegation of the Russian Federation and Deputy Director of the Department for Non-Proliferation and Arms Control at the Ministry of Foreign Affairs, Konstantin Vorontsov, spoke before the First Committee of the UN General Assembly on October 3, 2022. Vorontsov expressed apprehension regarding the utilization of civilian and commercial space infrastructure for military purposes by the United States and its allies, emphasizing the legal concerns associated with such actions, particularly in the context of ongoing events in Ukraine.[380]

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[377] Stephens, *supra* note 18 at 77.

[378] "'We Have Not Passed the Point of No Return', Disarmament Committee Told, Weighing Chance Outer Space Could Become Next Battlefield", (26 October 2022) at para 43, online: *Seventy-Seventh Session, 22nd Meeting (PM) GA/DIS/3698* <https://press.un.org/en/2022/gadis3698.doc.htm>.

[379] Brian T. Bohan, "Developing technology with allies and partners" (27 July 2023) at para 24 online: *Air University (AU)* <https://www.airuniversity.af.edu/Aether/Articles/Article-Display/Article/3472776/developing-technology-with-allies-and-partners/>.

[380] "Statement by Mr. Konstantin Vorontsov at the Thematic Discussion on Nuclear Weapons in the First Committee of the 77th Session of the UN General Assembly, New York, 17 October 2022", (19 October 2022) at

Although not the first instance of space warfare, the conflict in Ukraine represents a unique development as it incorporates exo-atmospheric space into military operations in a novel and structured way.[381]

The exponential growth in private space investment, exemplified by projects like SpaceX's Starlink, showcases a shift in the sector.[382] Notably, countries lacking space assets, like Ukraine, depend on private companies, emphasizing the evolving reliance on third-party aid.[383] This dependency, fraught with uncertainty, undermines the position of LTACs in the rapidly evolving landscape of space warfare.

Ukraine's technological limitations, evident in the absence of national space assets, made it susceptible to cyber-attacks on systems like Viasat during the conflict's initial phases. Russia, mindful of escalating tensions, tactically exploited this vulnerability, highlighting the difficulties faced by less advanced nations in the changing warfare landscape.[384]

The successful Viasat cyberattack caused widespread damage, affecting internet users and wind farms in central Europe, leading to EU involvement in the conflict.[385] While some argue that

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para 3, online: *Ministry of Foreign Affairs of the Russian Federation*, <https://www.mid.ru/en/foreign_policy/news/1834379/>.

[381] Anne Maurin, "The War in Ukraine and Space Theatre" (2023) HS11 Revue Défense Nationale (N° Hors-série) 30 at 37 (Cairn.info).

[382] Bender, Miller, Scott, *supra* note 273 at para 3.

[383] Samuel Stockwell, "Legal 'black holes' in Outer Space: The regulation of private space companies", (20 July 2020) at para 7, online: *E-International Relations* <https://www.e-ir.info/2020/07/20/legal-black-holes-in-outer-space-the-regulation-of-private-space-companies/>.

[384] Beyza Unal, & Mathieu Boulègue. "Russia's behaviour risks weaponizing Outer Space", (27 July 2020) at para 5, online: *Chatham House* <https://www.chathamhouse.org/2020/07/russias-behaviour-risks-weaponizing-outer-space>.

[385] Patrick Howell O'Neill, "Russia hacked an American satellite company one hour before the Ukraine invasion", (11 May 2022) at para 10, online: *MIT Technology Review* <https://www.technologyreview.com/2022/05/10/1051973/Russia-hack-viasat-satellite-ukraine-invasion/>.

Ukraine's reliance on alternative means mitigated the impact[386], the attack significantly disrupted communications and satellite networks, posing challenges for leaders to connect with front-line soldiers and necessitating physical movements for orders.[387]

At the onset of the conflict, each belligerent actively pursued the acquisition of space assets, effectively establishing a proportional balance of assets within the domain by forming two coalitions. Presently, Russia boasts an extensive operational fleet of satellites across various types, though its capacity for radar observation through cloud cover remains limited.[388] Nonetheless, the noted errors in Russian attacks indicate problems with directed ammunition supplies or their calibre. The smooth integration of all space assets is hampered by the Russian ground troops' inherent logistical problems and lack of coordination.[389] Russia's military errors in the conflict with Ukraine primarily stemmed from a pervasive underestimation of the Ukrainian army and a failure to plan adequate logistical support. High-level Russian leadership displayed unwarranted confidence, expecting swift victory and neglecting preparedness. This miscalculation resulted in insufficient supplies and a reliance on precision-guided munitions, depleting resources and forcing a shift to unguided artillery, rockets, and tactical missiles. The long-range strike capability of the Russian military was significantly compromised as a consequence.[390] Recent occurrences, such the devastation of vital infrastructure in Ukraine,

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[386] Paul Sonne et al., "Battle for Kyiv: Ukrainian valour, Russian blunders combined to save the capital", (August 2022) at para 5, online: *Washington Post* <https://www.washingtonpost.com/national-security/interactive/2022/kyiv-battle-ukraine-survival/>.

[387] Matt Burgess, "A mysterious satellite hack has victims far beyond Ukraine", (23 March 2022) at para 4, online: *WIRED UK* <https://www.wired.co.uk/article/viasat-internet-hack-ukraine-russia>.

[388] Bart Hendrickx, "Upgrading Russia's fleet of optical reconnaissance satellites", (10 August 2020) at para 28, online: *The Space Review* <https://www.thespacereview.com/article/4006/1>.

[389] Maurin, *supra* note 381 at 33.

[390] Lyle Goldstein & Nathan Waechter. "China ponders Russia's logistical challenges in the Ukraine War", (28 August 2023) at para 7-8, online: *RAND Corporation* <https://www.rand.org/pubs/commentary/2023/08/china-ponders-russias-logistical-challenges-in-the.html>.

point to possible improvements in the tools or techniques that the Russian military uses to target.[391] One such example is the February 10, 2023, bridge destruction in the Odessa region, which highlights possible improvements in Russian targeting capability.[392]

5.3.1 Private Industry in Space Coalitions: Empowering Ukrainian Forces

At the onset of the conflict, Russian space capabilities faced opposing forces in Ukraine that lacked a satellite infrastructure. In response, Ukrainian forces sought international assistance, establishing a coalition with dual-use capabilities focused on space warfare. Collaborating with foreign governments and private entities like EOS Data Analytics, the Ukrainian government appealed for the availability of satellite assets.[393]

In response to this request, businesses like Maxar Technologies and Planet contributed their imaging capabilities. Relay aerials and quickly deployable Starlink satellites met the communication needs of Ukrainian soldiers close to the front line.[394] This strategy, however, is risky, particularly if the front line moves, which might make it difficult to secure and maintain infrastructure, including mobile components left behind in areas that Russian forces have taken.

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[391] Michael N. Schmitt, "Ukraine symposium – Attacking Power Infrastructure under international humanitarian law", (20 March 2023) at para 3, online: *Lieber Institute West Point* <https://lieber.westpoint.edu/attacking-power-infrastructure-under-international-humanitarian-law/>.

[392] Pavel Olityuk, "Russian attacks on key bridge may affect Ukraine's grain export plans", (27 April 2022) at para 2, online: *Reuters* <https://www.reuters.com/world/europe/russian-attacks-key-bridge-may-affect-ukraines-grain-export-plans-2022-04-27/>.

[393] Marit Undseth & Claire Jolly, "A new landscape for space applications: Illustrations from Russia's war of aggression against Ukraine" (2022) OECD Science, Technology and Industry Policy Papers 28 at 29.

[394] Valentina Chabert, "The Outer-Space Dimension of the Ukraine Conflict" (2023) 75: 2 J. Int. Aff. 145 at 148 (JSTOR).

By adding commercial equipment to their operations—such as attaching Starlink antennas to mini-drones—Ukrainian forces displayed inventiveness.[395]

Initially, American corporations responded by claiming that the equipment was for civilian use and then admitting that it had limited military application. Though, Elon Musk, SpaceX's CEO, revealed that Starlink played a crucial role in supporting Ukraine's communication, particularly on the front lines where traditional internet connectivity faced challenges.[396] However, using commercial equipment presents challenges as it relies on the supplier's generosity. Ukraine's dependence on non-state space-related intelligence capabilities, facilitated by global private sector partnerships, surprised Russia. The operational effectiveness of this collaboration marked a shift in Russia's historical reluctance to embrace private enterprise in the space domain.[397] Furthermore, this reliance on commercial assets became a strategic imperative for a nation navigating a conflict without the technological prowess of its adversary.

The evolution from private to state involvement in providing satellite services, exemplified by SpaceX's transition from initial aid to a Department of Defense contract for Ukraine[398], raises

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[395] Jon Bateman, "Russia's Wartime Cyber Operations in Ukraine: Military Impacts, Influences, and Implications", (16 December 2022) at 43, online (pdf): *Carnegie Endowment for International Peace* <https://carnegieendowment.org/2022/12/16/russia-s-wartime-cyber-operations-in-ukraine-military-impacts-influences-and-implications-pub-88657>.

[396] Amritha Jayanti, "Starlink and the Russia-Ukraine war: A case of commercial technology and public purpose?", (09 March 2023) at para 10, online: *Belfer Center for Science and International Affairs* <https://www.belfercenter.org/publication/starlinkand-russia-ukraine-war-case-commercial-technology-and-public-purpose>.

[397] Egle E. Murauskaite, "U.S. assistance to Ukraine in the Information Space: Intelligence, Cyber, and signalling", (February 2023) at 13, online (pdf): *ICONS Project- University of Maryland* <https://www.start.umd.edu/publication/us-assistance-ukraine-information-space-intelligence-cyber-and-signaling>.

[398] Mike Stone, & Joey Roulette, "SpaceX's Starlink wins Pentagon contract for satellite services to Ukraine", (1 June 2023) at para 3, online: *Reuters* <https://www.reuters.com/business/aerospace-defense/pentagon-buys-starlink-ukraine-statement-2023-06-01/>.

challenges due to uncertainties in IHL and the Law of Neutrality, especially in the context of space warfare. The reliance on commercial entities like SpaceX, while initially advantageous, poses challenges for victims of aggression, notably LTACs. The limited generosity of private entities, driven by their own interests and external factors, underscores potential vulnerabilities for LTACs dependent on such aid. The geopolitical dynamics and commercial nature of these arrangements may not align with the strategic needs and interests of the victims of aggression, raising critical questions about the evolving role of private entities and states in shaping the landscape of space warfare aid.

5.4 Assessing Power Infrastructure Attacks within IHL

Power infrastructure emerges as a contentious yet pivotal subject within the framework of IHL. The US Department of Defense's Law of War Manual emphasizes the recognition of electric power stations as military objectives during armed conflicts, citing their significance in meeting a state's wartime needs.[399] Russia, in the ongoing conflict with Ukraine, aligns with this perspective, categorizing "energy systems" on par with unambiguously lawful military objectives like "military command systems" and "arsenals."[400]

However, IHL mandates that power infrastructure must genuinely qualify as a military objective before becoming a direct target. According to Article 52(2) of Additional Protocol I, military objectives are objects that by their nature, location, purpose, or use, contribute effectively to military action, and their destruction offers a definite military advantage in the

[399] US Department of Defence (DoD), Law of War Manual, Office of General Counsel, Washington, DC, 2023, § 5.6.1.2.

[400] Matthew G. Looper, "International Space Law: How Russia and the U.S. Are at Odds in the Final Frontier" (2022) 18:2 S.C. J. Int'l L. & Bus. 132 at 136.

prevailing circumstances.[401] The United States controversially designates "war-sustaining" objects, such as oil destined for export or power generation infrastructure supporting key industries, as military objectives.[402] Since these economic targets play a crucial role in financing the war effort. However, targeting food or food-specific infrastructure, like grain silos, is expressly prohibited by Protocol I, article 54(2), unless they exclusively sustain combatants.[403] Therefore, even if Russia's primary intent is to pressure global food supplies and ease sanctions, such actions violate this prohibition. The targeting of food and its infrastructure is only permissible only if it provides "direct support to military action" without causing civilian starvation, as outlined in Protocol I, article 54(3)(b).

Therefore, the assessment of 'industries generating income' must be conducted meticulously on a case-by-case basis, ensuring a clear understanding of their utilization in armed conflict. Since, under the war-sustaining theory of military objectives, general support to the economy is not considered direct support to military action. Consequently, attacks on Ukraine's Black Sea ports, which are generally not indispensable to civilian survival, should be analysed under the ordinary rule of distinction. Certain port elements may qualify as military objectives based on strategic criticality by location; however, any attack must meticulously adhere to the requirements of proportionality and precautions, demanding detailed, case-specific evaluations.[404]

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[401] Protocol Additional to the Geneva Conventions of 12 August 1949, and relating to the Protection of Victims of International Armed Conflicts (Protocol 1), 8 June 1977, 1125 UNTS 3, 1991 ATS No 29/16 ILM 1391 (1977) (entered into force 7 December 1978), Article 52(2) [Additional Protocol I or API].

[402] US Department of Defence (DoD), Law of War Manual, Office of General Counsel, Washington, DC, 2023, § 5.6.8.5.

[403] Buchan, *supra note* 232 at 752.

[404] Tom Dannenbaum, "International humanitarian law and Russia's termination of the Black Sea Grain Initiative", (28 August 2023) at para 3, online: *Fletcher Russia and Eurasia Program*

However, this expansive definition faces widespread rejection from most states and international law experts. The International Law Association Study Group asserts that objects contributing to the enemy's war-sustaining effort do not qualify as military objectives, and this position lacks a basis in current law.[405] Economic targets, encompassing entities or infrastructure with economic significance, become a focal point for military attacks or strategic considerations. The concern arises from the potential labelling of such targets as war-sustaining, creating a risk that malevolent states, exemplified by Russia's actions in Ukraine, could exploit this categorization to justify their attacks.[406]

5.4.1 Proportionality in Power Infrastructure Attacks

The ongoing power infrastructure attacks in the Russia-Ukraine conflict necessitate a nuanced understanding of IHL principles. Proportionality, a core tenet of IHL, requires that the anticipated military advantage be balanced against potential harm to civilians and civilian infrastructure. Doubts arise regarding whether all targeted power infrastructure genuinely qualifies as a military objective,[407] and striking infrastructure that fails to meet this criterion violates the explicit prohibition on attacking civilian objects outlined in Additional Protocol I Article 52(1) and customary law. This underscores the necessity of a precise and careful assessment to ensure compliance with IHL principles. The debate over Russian attacks on Ukraine's electrical grid introduces uncertainty in assessing the proportionality of such actions,

<https://sites.tufts.edu/fletcherrussia/what-you-need-to-know-international-humanitarian-law-and-russias-termination-of-the-black-sea-grain-initiative/>.

[405] International Law Association Study Group on the Conduct of Hostilities in the 21st Century, "The Conduct of Hostilities and International Humanitarian Law: Challenges of 21st Century Warfare" (2017) 93 Int'l Law Stud. 322 at 341.

[406] *Ibid* at 342.

[407] Stephanie van den Berg, "Explainer: When are attacks on civilian infrastructure war crimes?", (16 December 2022) at para 14, online: *Reuters* <https://www.reuters.com/world/europe/when-are-attacks-civilian-infrastructure-war-crimes-2022-12-16/>.

as the proportionality analysis includes indirect loss, those with a causal link to the attack but not immediately caused by it. The position taken by the DoD Law of War Manual in ¶ 5.12.1.3 further emphasizes considering harm to civilians caused by the destruction of a power plant, introducing complexity in evaluating excessive harm.[408] The contentious nature of power infrastructure, with its potential dual-use nature, serving both civilian and military purposes, contributes to the ongoing debate in international law and presents challenges in definitively categorizing it as a military objective.[409]

5.4.2 Disproportionate Attacks: Humanitarian Impacts for LTAC

The indiscriminate targeting of power infrastructure may lead to disproportionate impacts on civilians, violating the principles of proportionality and distinction.[410] Russian attacks on Ukrainian power infrastructure are subject to dual thresholds: the targeted site must qualify as a military objective, and the anticipated military advantage must outweigh potential harm to civilians and civilian objects.[411] Even if meeting these criteria, the disproportionate impact on Ukrainian civilians extends beyond initial explosions, affecting medical care, emergency response, and essential services for over 10 million homes.

Ukraine's status as a less technologically advanced country accentuates the severity of civilian harm. In the absence of robust internal technological capabilities, the nation faced significant

[408] US Department of Defence (DoD), Law of War Manual, Office of General Counsel, Washington, DC, 2023, § 5.12.1.3.

[409] Charlie Dunlap, "Is attacking the electricity infrastructure used by civilians always a war crime?", (31 January 2023) at para 82 online: *Lawfire Blog* <https://sites.duke.edu/lawfire/2022/10/27/is-attacking-the-electricity-infrastructure-used-by-civilians-always-a-war-crime/>.

[410] Schmitt, "Ukraine symposium", *supra* note 391 at para 3.

[411] Protocol Additional to the Geneva Conventions of 12 August 1949, and relating to the Protection of Victims of International Armed Conflicts (Protocol 1), 8 June 1977, 1125 UNTS 3, 1991 ATS No 29/16 ILM 1391 (1977) (entered into force 7 December 1978), Article 51(5)(b).

challenges in proving the breach of international law to its advantage.[412] The reliance on commercial assets further complicates matters, subjecting Ukraine to the goodwill of private companies and their willingness to support military objectives. This underscores a unique vulnerability, emphasizing the need for tailored legal frameworks that consider the challenges faced by less technologically advanced nations in conflicts involving advanced space capabilities.

5.4.3 Balancing Civilian Protection: Targeting Power Infrastructure

The ongoing conflict in Ukraine underscores the importance of adhering to international humanitarian law, particularly regarding precautions in attack. Even when targeting power infrastructure is deemed a military objective in the 2023 DoD Law of War Manual, Russia must comply with Article 57 of Additional Protocol I, and Customary law.[413] The 2023 DoD Law of War Manual imposes an obligation to choose methods and means of warfare that minimize incidental harm to civilians and civilian objects.[414] The choice of carbon filament bombs by the United States to neutralize power infrastructure provides a clear example of precautions that minimize the risk to nearby civilians. While not a recent event, this serves as an illustration.[415] Precision weapons, like carbon filament bombs, can be selected based on the unique

[412] Romina Bandura, Paula Reynal & Lena Leonchuk. "Ukraine's science, technology, and Innovation Ecosystem: An engine of economic growth" (5 April 2023) at para 2, online: *Center for Strategic and International Studies* <https://www.csis.org/analysis/ukraines-science-technology-and-innovation-ecosystem-engine-economic-growth>.

[413] John Cerone, "The Russia-Ukraine War: Who and What Can Be Targeted Under International Humanitarian Law", (29 March 2022) at para 15, online: *Raoul Wallenberg Institute* <https://rwi.lu.se/blog/the-russia-ukraine-war-who-and-what-can-be-targeted-under-international-humanitarian-law/>.

[414] US Department of Defence (DoD), Law of War Manual, Office of General Counsel, Washington, DC, 2023, § 5.4.3.1.

[415] Michael N. Schmitt and Eric W. Widmar, "On Target: Precision and Balance in the Contemporary Law of Targeting" (2014) 7 J. Nat'l Sec. L. & Pol'y. 379 at 402.

circumstances of an operation.[416] The absence of comparable alternatives in Russia's arsenal prompts questions about the practicality of reducing civilian harm further when targeting specific components of power infrastructure.[417]

The principle of proportionality adds another layer to this complexity. When selecting between military objectives with similar advantages, the attacking party must choose the one causing the least danger to civilians.[418] Effective advance warning is also mandated when attacks may affect the civilian population. Yet, in the context of the conflict, warning civilians of power infrastructure attacks proves challenging due to interception capabilities, adding to the intricate balance between military necessity and civilian protection.

5.4.4 Power Infrastructure Attacks: Beyond Proportionality and Precaution

Several other legal considerations also come into play. Notably the question of whether power infrastructure attacks qualify as terrorism under international humanitarian law. While acts intended to spread terror among civilians are prohibited, determining primary purposes in the absence of clear evidence remains challenging. Additionally, the attacks must be scrutinized to ensure they are not indiscriminate, violating the prohibition on directly attacking civilian objects.[419] As both Russia and Ukraine are parties to Additional Protocol I, Russia must uphold the obligation of constant care to spare the civilian population, obliging careful consideration of potential adverse consequences for civilians, even if they fall outside the proportionality

[416] Schmitt, "Ukraine symposium", *supra* note 391 at para 8.

[417] Julia Ou, "Protection of Civilians and Human Right Violations: A Critical Examination of International Humanitarian Law in the Russo-Ukrainian Conflict" (2023) 2 Transactions on Social Science, Education and Humanities Research 349 at 349.

[418] Maroonian, *supra* note 245 at para 14.

[419] Pražák, "On the Threshold of Space Warfare", *supra* note 316 at 177.

rule's strict criteria. Balancing military objectives and the protection of civilians presents a formidable challenge in this evolving conflict.

5.5 UN General Assembly's Response to Russia's Actions in Ukraine

The UNGA has emerged as a crucial arena for addressing Russia's annexation of Ukrainian territory and the ongoing conflict. While the primary body responsible for international peace and security is the UN Security Council, Russia's permanent membership and veto power have created a deadlock, prompting the UNGA to play a significant role.[420]

In response to the situation in Ukraine, the UNGA activated the 'Uniting for Peace' procedure on February 27, 2022. This procedural move, exempt from the Security Council's veto, led to the creation of the 11th Emergency Special Session of the Assembly.[421] Resolutions adopted during these sessions, such as the condemnation of Russia's invasion and the humanitarian situation it created, hold political and legal significance.[422]

The powers of the General Assembly are distinct from those of the Security Council. Resolutions and decisions of the UNGA are considered 'recommendations' under Articles 10-14 of the UN Charter, lacking the legally-binding nature of certain Security Council decisions. Despite this, the UNGA retains residual responsibilities for maintaining peace and security.[423] Potential actions include recommending the use of military force under the Uniting for Peace

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[420] Patrick Butchard, "The UN General Assembly condemns Russia: But what can it actually do?", (14 October 2022) at para 3, online: *UK Parliament- House of Commons Library* <https://commonslibrary.parliament.uk/the-un-general-assembly-condemns-Russia-but-what-can-it-actually-do/>.

[421] Rebecca Barber, "The Evolving Role of the General Assembly vis-à-vis the Security Council in the Maintenance of Peace" (2023) 25:4 J. Int. Peacekeeping 305 at 308.

[422] Rebecca Barber, "An Early Assessment of the General Assembly's 2022 Veto Initiative" (2023) 29(3) Glo. Gov.: A Review of Multilateralism and International Organizations 346 at 356.

[423] Abbas Sadoon Refat, "The Role of the United Nations in Maintaining Global Security After the Ukrainian War" (2023) 33 J. Namib. Stud.: History Politics Culture 2448 at 2453.

resolution and suggesting coordinated sanctions through the doctrine of countermeasures. While the possibility of peacekeeping in Ukraine has been raised, no tangible progress has been observed, and some Western states have independently imposed sanctions on Russia, bypassing UNGA coordination.[424]

Despite its role as an international organization tasked with addressing global issues, the UNGA faces limitations in directly intervening or providing substantial assistance to Ukraine in the context of space warfare and the deployment of dual-use assets by Russia. The UNGA's powers, largely rooted in recommendations and lacking the binding force of the Security Council, hinder its ability to take decisive actions, especially against a permanent Security Council member like Russia.[425] As Ukraine grapples with the intricate challenges of contemporary space warfare and the use of dual-use assets, the UNGA's scope for impactful intervention remains constrained, emphasizing the complexities and constraints inherent in addressing such multifaceted issues within the international legal framework.

5.5.1 UNGA Condemnation: Shaping Neutrality Norms

The UNGA's condemnation of the Russian invasion shapes norms against aggression but its impact on aiding victims remains uncertain. While fostering consensus on international law, the practical translation into meaningful assistance depends on complex geopolitical dynamics, institutional limitations, and member state priorities. Lacking enforcement authority, the UNGA relies on individual state actions, making the extent of direct benefits to those affected elusive. However, in the specific realm of dual-use space assets, the UNGA's condemnation

[424] Patrick, *supra* note 299 at para 5.

[425] Anna Borshchevskaya, "Regional Ambivalence Towards Russia and Ukraine" in Adib Farhadi, Mark Grzegorzewski, Anthony J. Masys, *The Great Power Competition - The Russian Invasion of Ukraine and Implications for the Central Region,* Volume 5 (Cham: Springer Nature Switzerland, 2023) 19 at 24.

gains heightened significance due to the uncertainties surrounding their adherence to both IHL and neutrality regulations.[426] This is notable in its uneven impact on less technologically advanced nations. The UNGA's firm stance shapes customary international law, emphasizing condemnation of aggression and preservation of neutrality as crucial norms. Furthermore, it has the potential to influence states' legal obligations, triggering a reassessment of commitments related to conflicts involving dual-use space assets, with a shared recognition that aligning with aggressors contradicts global community principles. While the UNGA's condemnation serves as a noteworthy gesture, it is crucial to acknowledge the limitations inherent in its non-binding nature. Though these condemnations contribute to normative development, their impact on addressing the plight of victims may be limited by the complex realities of international relations and legal enforcement.

5.5.2 Neutrality Law in Russian-Ukrainian Conflict: Global Perspectives

The Russian-Ukrainian conflict elicits divergent views on the law of neutrality. One perspective explores potential exemptions, such as the benevolent/qualified neutrality theory, allowing neutral states to discern between belligerents even without UN Security Council measures.[427] However, the United States and European Union members explicitly tied military support to Ukraine's right to self-defense, citing exceptional circumstances arising from Russia's blatant violation of the UN Charter.[428]

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[426] Ivan U K. Klyszcz, "It is not about 'neutrality': How the global south responds to Russia's invasion", (30 January 2023) at para 1, online: *Heinrich Böll Stiftung* <https://www.boell.de/en/2023/01/30/it-not-about-neutrality-how-global-south-responds-russias-invasion>.

[427] Allison Gaul, "Neutrality in the Digital Battle Space: Applications of the Principle of Neutrality in Information Warfare" (2013) 29 Syracuse J. Sci. & Tech. L. 51 at 98.

[428] Wang, *supra* note 211 at para 5.

A notable aspect is the diverse responses of states to military aid. Some, like France and the Nordic and Baltic States, endorsed the benevolent/qualified neutrality approach, asserting Ukraine's right to self-defense and providing military support. Conversely, others, like Switzerland, adhered to a strict interpretation of neutrality, refraining from supplying lethal war material to either party.[429]

The legal debate further extends to the question of collective self-defense under Article 51 of the UN Charter. While some scholars argue for its implicit inclusion in the provision of military support, concerned states like Germany maintain that such assistance does not reach the threshold of collective self-defense. The absence of formal notifications to the UN Security Council further complicates this argument, emphasizing the complex legal terrain in justifying military aid.[430] While no strict obligation requires states to maintain neutrality, once they actively support a party in a conflict, the concept of collective self-defense under Article 51 of the UN Charter becomes central. Traditional neutrality principles may frown upon supplying "war material" to a belligerent, the qualified neutrality doctrine allows non-neutral acts in support of a victim of unlawful aggression.[431] Simultaneously, determining co-belligerency involves navigating the Geneva Conventions and principles of state responsibility. This means assessing the extent to which a state supporting Ukraine becomes intricately involved in the conflict, potentially taking on a status akin to that of a co-belligerent. This transformation of

[429] Roy Allison, "Russia, Ukraine and state survival through neutrality," (2022) 98(6) International Affairs 1849 at 1852.

[430] Carbonnier, *supra* note 257 at para 4.

[431] Andrew Cheatham, "A look at neutrality now - and after the Ukraine War", (26 September 2022) at para 11, online: *United States Institute of Peace* <https://www.usip.org/publications/2022/04/look-neutrality-now-and-after-ukraine-war>.

states into co-belligerents raises questions about whether such military aid aligns with the threshold of collective self-defense.[432]

Moreover, as these Western powers extend support to Ukraine, the disparities between technologically advanced countries and LTACs become apparent, shedding light on the challenges faced by the latter.

LTACs, despite contributing in terms of quantity or historical weaponry, grapple with a significant technological gap when addressing the complexities of modern conflicts. While they may provide low-tech or outdated military support, the multifaceted challenges of contemporary warfare require advanced strategic and tactical capabilities possessed by technologically superior nations. This technological divide leaves LTACs at a disadvantage in actively shaping conflict resolution outcomes. Moreover, navigating the legal intricacies of providing military aid becomes a formidable challenge for LTACs. Advanced nations, with their technological prowess, not only dictate the strategic landscape but also wield considerable influence in international law. In situations where legal frameworks for space warfare are uncertain, the dominance of advanced nations further strengthens their bargaining power at the international level.

The law of neutrality, rather than serving as an equalizer, becomes a reflection of the broader disparities in global technological capabilities, raising pertinent questions about the equitable participation of LTACs in international conflict scenarios.

[432] James A. Green, "The provision of weapons and logistical support to Ukraine and the jus ad bellum," (2023) 10(1) J. Use Force Int. Law 3 at 6.

5.6 Starlink in Russia-Ukraine War: Dual-Use and IHL Implications

The absence of a specific code of conduct for commercial space ventures underlines the unprecedented nature of Starlink's role, demanding a holistic legal examination. The US definition of collective self-defence, focusing on defending designated foreign forces, contrasts with Russia's interpretation, potentially leading to conflicting perspectives on the legal implications. While both Starlink and military contractors operate in the broader context of national security and technological advancements, their specific roles and contributions vary significantly. Starlink's emphasis on global connectivity aligns more with civilian infrastructure development, whereas military contractors are intricately linked to the armed forces' operational needs during conflicts; thus, bringing into light the need to effectively regulate commercial space actors.

Military necessity, a core LOAC principle justifying measures to defeat the enemy efficiently, comes into play as Starlink's support to Ukrainian military drones poses a significant threat to Russia's military capacity. Degrading Starlink could offer a considerable military advantage without endangering human lives, aligning with the principle of military necessity.

Starlink's classification as a ‘military objective’ hinge on its role in facilitating military communications for Ukraine’s aid against Russian forces, leading to loss of life and damage to military equipment.[433] The US stance emphasizes that civilians involved in combat lose LOAC protection during that period, potentially making Starlink a legitimate target for the Russian military.[434] If Russia decides to act against Starlink, the US faces a dilemma, necessitating a

[433] Micah Maidenberg, “SpaceX Limits Ukraine’s Military Use of Starlink Satellite Business”, (8 February 2023) at para 3, online: *Wall Street Journal* <https://www.wsj.com/articles/spacex-to-limit-ukraines-military-use-of-starlink-satellite-business-11675894401>.

[434] Kaushik Ray and William Selvamurthy, "Starlink’s Role in Ukraine: Portent of a Space War?" (2023) 17:1 Journal of Defence Studies 25 at 38.

diplomatic or military response. The inherent right of self-defence, recognized by Article 51 of the United Nations Charter, may justify pre-emptive action in response to a perceived threat. Furthermore, Pentagon's acknowledgment of Starlink's role in providing essential communication capabilities for Ukraine and the military contracts with Starlink highlight its importance to U.S. defense. Therefore, in the context of the Russia-Ukraine war, where the dynamics of space assets intertwine with geopolitical tensions, the question of targeting Starlink becomes not just a military consideration but also a potential escalation that may involve the interests of the United States. The legal ambiguity surrounding Starlink's role underscores the need for comprehensive international legal frameworks governing commercial space ventures in conflict zones.

The evolving situation involving Starlink in the Russia-Ukraine conflict exposes significant gaps in IHL. Firstly, there is a lack of clear regulation for dual-use assets in space within the existing IHL framework, resulting in ambiguity regarding the legal status and treatment of assets like Starlink that serve both civilian and military purposes. Secondly, IHL lacks a comprehensive definition of what constitutes a military objective in space, especially concerning communication satellites, making it challenging to assess the lawfulness of targeting such assets. Additionally, the current legal framework inadequately addresses the status and regulation of commercial space ventures during armed conflicts, leaving questions about the rights, obligations, and legal consequences of entities like Starlink in conflict zones. Addressing these gaps is imperative for adapting IHL to the complexities of modern warfare, ensuring the protection of civilian infrastructure, and promoting equitable participation in armed conflicts.

5.7 Conclusion

Following a comprehensive examination of aid provision complexities within the constraints of IHL principles and potential scenarios involving Russia's potential targeting of critical defense assets, such as Starlink, crucial questions have emerged regarding the application of IHL in these contexts. Insights derived from the Ukraine-Russia conflict have significantly contributed to a comprehensive understanding of the lessons learned within the framework of the LOAC and IHL.

As the implications for LTACs were considered, the discourse expanded to assess whether the current legal framework appropriately takes into account the subtleties of space warfare has been a fundamental question raised by this study journey. Essentially, this last chapter highlights the technological as well as legal disadvantage that some countries experience by combining legal analysis with actual events to illuminate the suitability of current regulations.

The war between Russia and Ukraine highlights the need for a more thorough and sophisticated approach to applying IHL principles to space-based dual-use assets. IHL guidelines offer a helpful foundation for protecting LTACs, but they are insufficient on their own to handle the particular difficulties brought on by space combat. Therefore, a proactive and flexible approach to legal frameworks is needed as space warfare develops. This entails encouraging cooperation between governments and interested parties, putting a focus on the creation of new legal standards for the particular difficulties posed by space combat.

CHAPTER VI - CONCLUSION

This study aims to comprehensively scrutinize the dual-use nature of satellites serving both civilian and military needs, and their implications for LTACs countries particularly against the backdrop of the Ukraine-Rusia war. It predominantly focuses on the evaluation of the effects of dual-use satellites on IHL/LOAC.

The ongoing Ukraine-Russia conflict underscored the critical importance of space technology in modern warfare, with both countries extensively utilizing space-based systems for an array of military and civilian applications. This scenario has accentuated the challenges in effectively enforcing IHL principles like military necessity, precaution, proportionality, and distinction for dual use assets within the ambit of space warfare. Furthermore, the utilization of dual-use technologies in space warfare significantly challenges LTACs, leaving them vulnerable and disadvantaged in protecting their sovereignty and citizens due to the complexities of space warfare and the absence of clear regulations and guidance on the deployment of dual-use assets.

Examining the intensifying rivalry in space warfare through the lens of the Ukraine-Russia war serves as the focal point of the second chapter of the thesis. The text begins by distinguishing between two concepts: the weaponization and the militarization of space. Weaponization involves placing offensive armaments in space, contrasting with militarization, which pertains to utilizing space for military objectives. This distinction is essential to prevent misunderstandings and offer a sound legal analysis to identify the existing gaps in the legal framework. Despite the existence of space arms control regimes aiming to prevent the weaponization of space, there are notable gaps that leave room for potential hostile use. The chapter proposes refinements to these space arms control measures.

Continuing the exploration, the conflict between Russia and Ukraine is scrutinized for its repercussions in the realm of space. Emphasis is placed on comprehending the legal and policy frameworks governing space activities. The impact of this conflict on Ukraine's space sector is particularly underscored, as it grapples with limitations on accessing essential technology and infrastructure, positioning the country at a strategic disadvantage in comparison to Russia. Nevertheless, the chapter asserts that nations with limited technological advancements, such as Ukraine, possess the agency to actively contribute to the formulation of legal and policy frameworks in space through participation in global dialogues and negotiations.

In light of the multifaceted challenges arising from the dual nature of space technology and the dynamic characteristics of space activities, Chapter 3 emphasizes the imperative need for a nuanced application of IHL principles in the context of space warfare. The existing legal frameworks, primarily conceived for terrestrial conflicts, are deemed insufficient when confronted with the intricacies of space warfare. The chapter contends that these inadequacies necessitate the formulation of new guidelines and protocols tailored explicitly to address the unique challenges posed by the dual-use nature of space assets. The call for a thorough reassessment and amendment of existing legal frameworks is driven by the recognition that space warfare introduces unprecedented complexities. The legal principles, including principles of precaution, proportionality, and distinction, fall short in comprehensively addressing the intricacies of conflicts beyond Earth's atmosphere.

Distinguishing between military and civilian objects becomes notably challenging due to the dual-purpose nature of space assets, such as satellites, blurring the lines between legitimate targets and protected civilian infrastructure. Proportionality assessments encounter difficulties in weighing potential military advantage against collateral damage, particularly when the destruction of dual-use satellites can impact critical civilian infrastructure and global communication networks. The principle of precaution faces heightened complexities in space

warfare, given the close proximity of satellites to potential targets and the potential for space debris to affect both human populations and vital global infrastructures. In advocating for the development of new guidelines and protocols, the chapter therefore seeks to address the gaps and uncertainties surrounding the application of IHL principles in space warfare. This proactive approach aims to ensure that legal frameworks are not only relevant but also effective in managing the challenges presented by the dynamic nature of space activities. By committing to this comprehensive reassessment, the international community can establish a foundation for a more equitable, inclusive, and adaptive legal framework capable of addressing the intricate dynamics of space warfare on a global scale.

Chapter 4 emphasizes the intricate role of dual-use space assets, especially against the backdrop of the ongoing Russia-Ukraine conflict. This section meticulously scrutinizes the application to dual-use space technologies of international law, underscoring the blurred distinctions between their civilian and military applications. It underscores the challenges in categorizing these technologies and the difficulties in uniformly applying legal norms. The chapter highlights the swift progression in space technology and the diversity of stakeholders, encompassing both governmental and private sectors, adding layers of intricacy to the international legal framework.

Chapter 5 offers a critical assessment of the efficacy of IHL in safeguarding LTACs in the context of space based dual-use assets, specifically in the scenario of the Russia-Ukraine conflict. It explores the complex challenges posed by the dual nature of space technologies, like satellites, and how LTACs struggle due to their limited technological capabilities and the absence of space-specific international legal frameworks. The chapter argues that while IHL provides basic protections, it is insufficient in fully addressing the unique challenges posed by space conflicts to LTACs. Furthermore, the absence of explicit regulations in space warfare leaves LTACs vulnerable, accentuated by the influence of technologically advanced nations in

international organizations, creating an imbalance that hinders LTACs' equitable participation in decision-making related to space conflicts.

The thesis underscores the vital need to understand the complexities of space warfare and IHL, especially regarding their implications for LTACs. Recognizing these complexities is key for LTACs to effectively navigate the challenges in space governance, protecting their national security interests while advocating for the non-aggressive use of space.

Space warfare, especially when involving countries with differing technological capabilities, presents intricate legal and humanitarian challenges that push the limits of current space law and international relations. In essence, the arms race in space poses grave threats to worldwide stability and creates significant disparities in strategic capabilities. LTACs must consider these risks in their space policy and security strategies, and engaging in international discussions and negotiations is essential for influencing the development of legal and policy frameworks for space activities. Such engagement is crucial to ensure that all nations can equitably benefit from space utilization and reduce the negative effects of space weaponization.

The analysis of dual-use assets in this thesis reveals a complicated scenario where civilian and military uses are increasingly blurred. This in-depth study brings to light the challenges posed by the dual-use nature of space technologies, marking it as a sign of broader geopolitical trends and rapid technological advancements. Dual-use assets, usable for both peaceful and military ends, pose unique regulatory challenges internationally. The progression of space technology, particularly satellites used for communication and surveillance, adds to these complexities.

The ongoing conflict between Russia and Ukraine serves as a pertinent case study in understanding the practical consequences of dual-use technologies and bringing to light the inadequacies in the existing international frameworks, which struggle to effectively regulate space activities for peaceful purposes.

The rising presence of privately-owned satellites, particularly those with dual-use capabilities, calls for a reassessment of traditional methods of space governance.

In essence, the dual-use nature of space assets reflects the intricate interplay between security considerations, technological advancements, and international legal structures. This situation demands an advanced and adaptable policy-making approach, aiming to balance the benefits of technological progress with the imperatives of national security and global stability. The ongoing developments in space technology, particularly evident in the Russia-Ukraine conflict, highlight the importance of collective efforts to refine international norms and establish clear guidelines for the responsible use of dual-use assets. This thesis underlines the urgency of addressing these challenges in an era characterized by increasingly ambiguous distinctions between civilian and military technology applications.

The emergence of space warfare poses unique challenges to conventional legal frameworks, particularly International Humanitarian Law (IHL). This study focuses on key IHL principles such as distinction, proportionality, and precaution in the context of space warfare, emphasizing the need for adaptation due to the absence of human presence on satellites and space stations. The dual-use nature of space assets complicates proportionality assessments, challenges the principle of distinction, and requires ongoing efforts to protect civilians. Neutrality principles face complexities in the intertwined civilian and military uses of space, and the United Nations Charter's applicability to modern space warfare scenarios reveals limitations. Additionally, the Outer Space Treaty struggles to regulate the dual-use nature of space technologies effectively. As space technologies become integral to both peaceful and military pursuits, there is a pressing need for a nuanced legal framework that navigates these intricacies and adapts to the evolving nature of space warfare, emphasizing the importance of detailed policy proposals to enhance the legal infrastructure.

The key recommendations include:

1. *Development of Dynamic Legal Structures:* There is a critical need for legal frameworks that are both proactive and adaptable, aligning with the changing dynamics of space warfare. These frameworks should establish new legal norms while addressing intertwined political and strategic considerations, with a focus on preventing conflicts and ensuring transparent use of space-based dual-use assets. The existing Outer Space Treaty, while foundational, falls short in adequately addressing the complexities surrounding dual-use assets in the contemporary space landscape, necessitating a more comprehensive and updated approach.
2. *Encouraging Global Cooperation*: Advanced space-faring nations should commit to sharing knowledge and providing technological assistance to LTACs, promoting a fair and balanced approach to space exploration and governance.
3. *Revision of Existing Legal Norms*: Current legal standards must be revised to accurately mirror the realities of space warfare, especially for LTACs, drawing lessons from contemporary conflicts such as the Russia-Ukraine situation.
4. *Strengthening LTACs*: Boosting the technological and legal capabilities of LTACs is essential to enable their meaningful engagement in space operations. Furthermore, LTACs should have an equitable role in decision-making to avoid biases and ensure a fair representation of interests. Empowering LTACs with the knowledge and skills necessary for effective space governance participation ensures a more inclusive and equitable global approach to space-related matters.
5. *Active Diplomatic Engagement*: Proactive diplomatic efforts are vital to shape international agreements promoting the peaceful use of space. Diplomacy must specifically address dual-use concerns, ensuring clear guidelines on the responsible deployment of space assets for both civilian and military purposes. This approach fosters cooperation and helps prevent

conflicts while accommodating the unique challenges faced by LTACs in navigating the dual-use landscape.

6. *Role of International Organizations*: International entities play a pivotal role in creating standardized norms for space activities. Addressing dual-use complexities, they can advocate for inclusive practices, safeguarding LTACs' interests. By providing mediation platforms, these organizations contribute to fair conflict resolution, ensuring a balance between advancing space capabilities and equitable global participation, particularly for nations with less technological advancement.

Implementing these policy recommendations requires a multifaceted strategy to refine the legal framework governing space warfare. This approach aims to ensure comprehensive, flexible, and cooperative protection for all nations, particularly LTACs, within the challenging environment of space conflict. It is vital to incorporate these recommendations into the existing legal fabric to effectively navigate the complexities of safeguarding LTACs in the context of space warfare.

6.1 Concluding Reflections and Future Prospects

The study concludes by highlighting the impact of the dual-use phenomenon in space on LTACs within the context of armed conflicts like the Russia-Ukraine war. It emphasizes the intricate relationship between technological advancements, legal frameworks, and geopolitical contexts, underscoring the urgent need for legal structures to adapt to the rapidly advancing field of space technology.

Future research directions suggested by this study include further examination of the adaptation of space law to technological advancements, the influence of new participants in space, challenges in governing space law, and the legal ramifications of space technology

developments. The principles of equality and solidarity in space law merit additional exploration, particularly considering the ongoing militarization of space.

The importance of this study lies in its contribution to a rapidly changing area at the confluence of international law, space technology, and global security. With the exponential increase in space activities driven by a mix of state and non-state actors, the call for a comprehensive, responsive, and fair legal framework is more pressing than ever. This thesis not only analyses the current situation but also encourages action from policymakers, legal experts, and technologists to collaboratively develop solutions that ensure peaceful and equitable space utilization, especially for LTACs.

In conclusion, this thesis marks a significant contribution to understanding the complex nature of space warfare and its legal implications. It lays the groundwork for further academic research, enhancing knowledge crucial for navigating the emerging challenges of space in a way that respects human rights, international law, and global peace and security.

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