Analogues between Space Law and Law of the Sea/International Maritime Law: Can Space Law Usefully Borrow or Adapt Rules from These Other Areas of Public International Law?

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Abstract

Space Law is a part of (or a sub-specialty within) public international law. Space law borrowed in its formation from the Antarctic Treaty, and more recently suggestions have been made that the space law regime could usefully draw models from international air law. Less explored are possible models the space law regime could borrow, with appropriate adaptations, from the Law of the Sea and international maritime law. Indeed, this examination reveals that the Law of the Sea, specifically the detailed duties it lays out for flag states regarding vessels, and international maritime law, specifically principles of liability salvage or salvage awards based on efforts to protect the environment, may provide useful analogues, if appropriately adapted, in the space law regimes' efforts to combat space debris. Thus, space law in its evolution must be careful to look towards multiple other public international law regimes in its search for adaptable models to solve vexing problems of outer space activities, such as the issue of space debris.

I Introduction

In the early years of space exploration and activity, only two governments were active in outer space. Space debris was limited and not necessarily of much

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interest or concern nor was space traffic management generally. However, in fifty-five years since the Soviet government launched the first satellite, Sputnik, in 1957, and the forty-five years since the entry into force of the primary space law treaty, the Outer Space Treaty (OST), there have been tremendous changes and advancements in the nature of space activities and number of actors involved in space activities. Ten nations maintain launch capacity to space today, well over sixty have satellites in space, and nearly all benefit from or use satellite data or communications capacities in some form. A US commercial company, Space Exploration Technologies (SpaceX) became the first commercial entity to successfully launch and recover an object from Earth orbit in December 2010, a milestone only six nations achieved in the fifty-five years of space exploration. SpaceX subsequently completed a successful cargo run to the International Space Station (ISS) in May 2012 and NASA is relying on commercial companies to ultimately provide both cargo and crew carriage to the (ISS), having retired the Shuttles. Communications and remote sensing satellites have long been part of the space environment, benefiting people in their banking, agricultural planting, sea traffic and air navigation, as well as telecommunications needs, but today space entrepreneurs are creating new space markets. For example, Virgin Galactic has collected well over 500 deposits for seats on its sub-orbital flights, not only from space tourists but also from those wishing to conduct zero-gravity research. The company will begin flights from Spaceport America in New Mexico likely sometime in late 2013. Additionally, Bigelow Aerospace has successfully launched prototypes of its inflatable space hotels and research stations in 2007 and is awaiting commercial human transport to serve its future stations. Along with this increased activity in outer space is a growing concern that space debris, man-made non-functional space objects, such as old rocket bodies, dated satellites, and fragments from collisions among space objects, both intentional and unintentional, will hamper or at least increase the risk for future space activities. Indeed, the problem of space debris, and how to mitigate or remediate such debris, is fast becoming one of the key technological and legal issues confronting users of space.[1] US Strategic Command (USSTRATCOM) through its Space Surveillance Network (SSN) is able to track objects basically the size of a softball (10 cm). There are roughly 23,000 such objects tracked by STRATCOM's SSN, of which 16,000 have known origin. Roughly only 5% of these objects, around a thousand, are active satellites, the remainder being debris. China, Russia and the United States are responsible for 90% of the catalogued debris. It is estimate that there are roughly half a million pieces of debris between 1cm and 10cm and these are the greatest risk to active satellites because they cannot be tracked and satellites cannot be hardened to withstand damage from objects this size. Existing debris *mitigation* efforts to limit the creation of *new* debris include non-binding international guidelines established

1 *See Towards Long-Term Sustainability of Space: Overcoming the Challenges of Space Debris*, Report of the International Interdisciplinary Congress on Space Debris, 3 February 2011, UN Doc. A/AC.105/C.1/2011/CRP.4 and 27 January 2012, UN Doc. A/AC.105/C.1/2012/CRP.16 [hereinafter "IICSD Reports"].

first by the major space agencies of the world cooperating in the Interagency Space Debris Coordinating Committee (IADC) in 2002, and later adopted, in substantially similar form, by the UN Committee on Peaceful Uses of Outer Space (COPUOS) in 2007.[2] Active debris *remediation* (ADR), specifically the removal of *existing* debris from outer space, and on-orbit servicing (OOS) of satellites, thereby extending satellites useful lives, a form of debris mitigation, have not yet begun in earnest, although much research and development of these technologies is underway.[3]

In seeking solutions or possible models to apply to the outer space legal regime, international air law is often turned to as a possible fruitful avenue for comparative research. For example, there are calls to create a space traffic management system based on the International Civil Aviation Organization (ICAO) system.[4] Less frequently turned to for possible models or solutions to the challenges of space regulation are the Law of the Sea and international maritime law.

When the Law of the Sea Convention (LOSC)[5] is turned to by space experts it typically involves a look at the deep seabed mining regime as a possible model for reform of the Moon Agreement's provisions on resource extraction and exploitation.[6] However, other elements of the LOSC regime outside the context of deep seabed mining issues may also hold some promise when we think of appropriate regulation of space activities. Specifically, the OST shares many common principles with LOSC's provisions that governing the High Seas, and arguably the Exclusive Economic Zone (EEZ) as well, such as non-sovereignty, rights of freedom of exploration and use, and requirements of peaceful purposes. However, when it comes to jurisdiction, duties and responsibilities over vessels and obligations on states to regulate such vessels, the LOSC regime governing these areas has some extra detail that could prove useful in buttressing the force of space debris mitigation guidelines adopted by the UN Committee on Peaceful Uses of Outer Space (COPUOS).

When international maritime law is examined for models or possible solutions for space related activities, one common area of that law often cited as being

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2 UN General Assembly Doc. A/62/20 (2007), Report of the UN COPUOS, at p. 53-56, available at <www.oosa.unvienna.org/pdf/gadocs/A_62_20E.pdf>. See, generally, Steve Mirmina, Reducing the Proliferation of Orbital Debris: Alternatives to A Legally Binding Instrument, 99 Am. J. Int'l L. 649 (2005).

3 *See* IICSD Reports, *supra* note 1.

4 *See, e.g.,* Tommaso Sgobba, *An International Civil Aviation Organization for Outer Space?* in SECURITY IN SPACE: THE NEXT GENERATION—CONFERENCE REPORT, 31 March–1 April 2008, United Nations Institute for Disarmament Research (UNIDIR) at 103.

5 *See, generally*, Myron H. Nordquist (ed.), UNITED NATIONS CONVENTION ON THE LAW OF THE SEA 1982: A COMMENTARY (1995).

6 *See, e.g.*, Rosanna Sattler, *Transporting a Legal System for Property Rights: From the Earth to The Stars*, 6 Chi. J. Int'l L. 23, 34 (2005); Jeremy L. Zell, Note, *Putting a Mine On the Moon: Creating an International Authority to Regulate Mining Rights in Outer Space*, 15 Minn. J. Intl. L. 489, 500-01 (2006).

potentially useful in the context of space debris remediation is the law of salvage.[7] However, little detailed analysis typically follows this suggested model and a more detailed examination reveals significant problems with attempting to utilize the traditional law of salvage in the context of space debris. Nevertheless, a little used and highly controversial aspect of the law of salvage, namely liability salvage that would allow an award if the salvor averted the salved vessel from liability to a third party, as well as recent internationally-agreed principles allowing salvage awards for efforts to save the environment from damage, may indeed provide useful models, if properly adapted.

This paper thus proceeds in two parts. First, it examines the LOSC regime's obligations on jurisdiction, duties and responsibilities of flag states in the context of the High Seas (and arguably EEZ too) to see if these might be usefully adapted by the space law regime, particularly in the fight against space debris. Second, it examines international maritime law's law of salvage as well as the specific doctrines of liability salvage and awards for protection of the environment in the context of space debris. It concludes that the Law of the Sea and international maritime law can indeed stimulate useful thinking in regards to solving regulatory challenges in the context of the space law regime, and may provide some potential models for solutions, if appropriately adapted, within the space domain.

II Law of the Sea Provisions on the High Seas (and EEZ): What Might the Space Law Regime Borrow with Appropriate Adaptations?

An examination of the LOSC's provisions regarding the High Seas, and perhaps also the EEZ, and the OST's provisions regarding outer space show significant common major principles. Both regimes prohibit claims of sovereignty by nations in these areas.[8] Both regimes elaborate significant rights to fundamental freedom of access and use bounded by an obligation to show "due regard" to other's activities.[9] Finally, both regimes limit the use of the areas for peaceful purposes and in both regimes that limitation does not mean no military use, but rather "no aggression or other use of force contrary to the United Nations Charter" in such areas.[10] While more arguable and less strictly overlapping, other similar notions and obligations apply in the LOSC and the OST regime regarding space, such as the obligation to take measures to ensure conservation of living resources in the LOSC whereas OST relies on a "non-contamination" obligation regarding extraterrestrial matter.[11] With this much commonality,

7 *See, e.g.,* Lyall and Larsen, SPACE LAW: A TREATISE (2009); Merges and Reynolds, *Rules Of The Road For Space?: Satellite Collisions And The Inadequacy Of Current Space Law*, 40 Environmental Law Reporter News & Analysis 10009 (January 2010)

8 *Compare* OST, Art. II with LOSC, Art. 89.

9 *Compare* OST, Art. I & IX with LOSC, Art. 87.

10 *Compare* OST, Art. IV with LOSC, Art. 88.

11 *Compare* OST, Art. IX with LOSC, Art. 117.

one might ask whether there are significant differences between the regimes that would allow for additional future borrowing between the two.

One regulatory challenge currently facing the OST regime is regulation of commercial space activities. Occasionally, one hears concerns regarding the possibility of a "flags of convenience" situation occurring in which some states would not sufficiently regulate space activities so as to encourage space entities to launch from their territory.[12] This concern has recently been elaborated in the context of patent protection in outer space activities.[13] More generally, there are concerns that certain countries are not aggressively enough implementing space debris mitigation guidelines through national licensing criteria.

The OST requires the "appropriate state party" to authorize and continually supervise the activities of its non-governmental actors (e.g. commercial entities) in outer space.[14] However, the OST gives no further details on what types of regulation or requirements a government should impose on private entities to meet its authorization and continuing supervision obligation. This problem of the lack of flesh in what must be done when authorizing and continually supervising is significantly mitigated by the OST making the appropriate state party "internationally responsible" for the activities of its non-governmental entities, a situation that certainly incentivizes such countries to appropriately regulate. Moreover, commercial space entities themselves have incredibly large incentives for safe operations, particularly in cases of the very early stages of human space flight and thus industry has even create self-regulation to fill in gaps in government regulation in certain instances.[15] Indeed, there is no appearance yet of a "flags of convenience" situation in outer space.[16] Nevertheless, one cannot dismiss the prospects of such a situation arising when the industry matures further. Additionally, countries should be maximizing opportunities to mitigate debris creation through authorization and continuing supervision obligations.

Several nations, most prominently the United States, have very detailed regulatory regimes for commercial launches and re-entries.[17] Other nations have very skeletal pieces of legislation affording much discretion on a case-by-case basis to national regulatory authorities,[18] although nation's typically look to other

12 *See* Frans von der Dunk, "Towards Flags of Convenience in Outer Space?," presentation to IISL-ECSL Symposium, March 19, 2012 (Vienna)(concluding not much risk currently but worth considering solutions to avoid in the future).

13 *See* Ro, Kleiman, & Hammerle, Patent Infringement in Outer Space in Light of 35 USC Sec. 105, 17 B.U. J. Sci. & Tech. L. (2011).

14 *See* OST, Art. VI.

15 *See, e.g.,* Schaefer, Formalism, Informalism, and Innovation in Space Law: Lenses to View, Assess, and Guide the Degree of Formalism in the Regulation of Space Activities, 51st IISL Colloquia on Law of Outer Space (2008) at 416.

16 *See* von der Dunk, supra note 12.

17 *See* Commercial Space Launch Act, 51 U.S.C. §§ 50901-23 (2011); 14 C.F.R. Part 400.

18 *See, e.g.,* von der Dunk (ed.), NATIONAL SPACE LEGISLATION IN EUROPE (2011).

nations with existing legislation or regulation prior to enacting their own. This "look, see, borrow" process does indeed help put flesh into Article VI's authorize and continually supervise obligation, but not in the sense of creating international obligations with regard to these more extensive details. The practice of nations is neither sufficiently universal nor consistent to create strong arguments that the extra flesh in national legislation has somehow become customary international law binding any nation seeking to regulate such activities.
Interestingly, the LOSC regime, applicable to a domain still criticized for flag of convenience problems itself, has more detailed specific duties and responsibilities for flag states regarding safe operations that go beyond the space regimes general authorization and continuing supervision obligations. The LOSC regime also makes it clear that flag states are to "effectively exercise" jurisdiction and control over ships flying its flags, while the OST regime states the state of registration of a space object "shall retain" jurisdiction and control leaving somewhat open whether the language is imposing an obligation, conferring a right that cannot be taken away, or some middle ground.[19] Additionally, difficulties with flag of convenience problems on the seas are increasingly being dealt with through further emphasis on port states undertaking additional inspections or regulation.[20] It will be difficult to use "port state" cures to any flags of convenience problems in commercial space, at least until point-to-point travel develops since satellites launched never return and space tourism will initially involve only "up-down" travel, with launch and landing occurring in the same nation.

A Clarity Regarding Which Nation Bears the Duty to Regulate

Before examining those more detailed duties and responsibilities, it is also important to note that the LOSC regime is clearer, although admittedly not perfectly clear,[21] as to which government bears those duties. In the OST regime,

19 *Compare* OST, Art. VIII, with LOSC, Art. 94(1).

20 *See, e.g.,* LOSC, Art. 219 and 1995 Straddling and Highly Migratory Fish Stocks Agreement, Art. 23 (both requiring ports states exercise some responsibility over vessels). *See, generally*, Michael Becker, "The Shifting Public Order Of The Oceans: Freedom Of Navigation And The Interdiction Of Ships At Sea," 46 Harvard Int'l L.J. 131, 186-187 (2005)("Although port state control has experienced "spectacular growth" over the past twenty-five years, the extension of port state controls to replace the ineffective control efforts by flag states has not been the result of unilateral port state action.")(*citing* Ronald P. Barston, *Port State Control: Evolving Concepts, in* LAW OF THE SEA: THE COMMON HERITAGE AND EMERGING CHALLENGES 87 (Harry N. Scheiber ed., 2000)).

21 The lack of absolute certainty arises out of LOSC Art. 91(1). It arguably imposes a "genuine link" requirement between registering state and ship. Some view this as a condition on nationality of ships. *See, e.g.,* 2 D. P. O'CONNELL, THE INTERNATIONAL LAW OF THE SEA 761 (1982). Other scholars argue the genuine link language is merely an aspiration or established through registration itself. *See, e.g.*, Edwin Anderson III, "The Nationality of Ships and Flags of Convenience: Economics, Politics, and Alternatives," 21 Maritime Lawyer 139, 149 (1996).

different terms are utilized in different articles. Additionally, some of these terms as defined can refer to multiple states. The result is that considerable complexity, and in some instances, considerable uncertainty, is created as to which states have which rights and duties.[22] For example, the OST uses the term "appropriate" State with respect to Art. VI's continuing supervision obligation of non-state actors, "registering" states in Art. VIII with respect to the right (and duty?) to "retain" jurisdiction and control over a space object, and "launching" state in Article VII with respect to liability for damage caused by a space object. In contrast, the LOSC regime typically, but not always, uses the common notion of "flag" state (via registration) to signal nationality. LOSC, unlike the OST, even foresees changes in the registration of ships, and thus flag states, when changes in ownership occur.[23] That omission by the OST, and the follow on Registration Convention, creates problems when one considers the sale of satellites or other changes in ownership of satellites.[24]

B. The More Detailed Duties of Flag States under LOSC As Compared with "Appropriate State" under OST as Regards Avoiding Collisions

The more detailed duties imposed under the LOSC regime on a flag state primarily can be seen through LOSC Art. 94, paragraphs 3-5:

Article 94
Duties of the flag State
…
3. Every State shall take such measures for ships flying its flag as are necessary to *ensure safety at sea* with regard, *inter alia*, to:
(a) the construction, equipment and seaworthiness of ships; (b) the manning of ships, labour conditions and the training of crews, taking into account the applicable international instruments; (c) *the use of signals, the maintenance of communications and the prevention of collisions*.
4. Such measures shall include those necessary to ensure:
(a) that each ship, before registration and thereafter at appropriate intervals, is surveyed by a qualified surveyor of ships, and has on board such charts, nautical publications and *navigational equipment and instruments as are appropriate for the safe navigation of the ship*;
(b) that each ship is in the charge of a master and officers who possess appropriate qualifications, in particular in seamanship, navigation, communications and marine engineering, and that the crew is appropriate in qualification and numbers for the type, size, machinery and equipment of the ship;

22 *See generally, e.g.,* Frans von der Dunk, *Sovereignty v. Space: Public Law and Private Launch in the Asian Context*, Singapore J. of Int'l L. 22-47 (2001); Frans von der Dunk, *Liability v. Responsibility in Space Law: Misconception or Misconstruction?* 34 IISL Colloquia on Law of Outer Space 363-371 (1991).

23 *See* LOSC, Art. 92.

24 *See generally*, Armel Kerrest, *Legal Aspects of Transfer of Ownership and Transfer of Activities*, Presentation to IISL-ECSL Symposium, March 2012 (Vienna), available at http://www.oosa.unvienna.org/pdf/pres/lsc2012/symp-01E.pdf.

(c) that the master, officers and, to the extent appropriate, the crew are fully conversant with and *required to observe the applicable international regulations concerning the safety of life at sea, the prevention of collisions, the prevention, reduction and control of marine pollution,* and the maintenance of communications by radio.
5. In taking the measures called for in paragraphs 3 and 4 *each State is required to conform to generally accepted international regulations, procedures and practices and to take any steps which may be necessary to secure their observance*.

In the space law regime, particularly as regards space traffic management and space debris mitigation and remediation, this LOSC language would need some adaptation but, nevertheless, do provide some interesting analogues. First, Art. 94(3) refers not only to the "seaworthiness" of ships and "training of crews," but also to the "use of signals, the maintenance of communications, and the prevention of collisions." Space situational awareness is of keen interest to the US military, numerous other governments, and private space actors in order to among other things prevent collisions between space objects or between debris or between debris and objects. Better sensors on satellites can help space situational awareness and enhanced tracking of debris and active satellites through STRATCOM's SSN.[25]
Article 94(4)'s more detailed obligations on vessel inspection and safety, crew training and qualifications, and reference to international standards on collision prevention and pollution control, as well as Article 94(5)'s reference that in so regulating a state is to conform to "generally accepted" practices, may provide interesting parallels in the fight against space debris. The UN COPUOS Guidelines on space debris mitigation could be considered "generally accepted"[26] and thus if there was a treaty obligation to follow those in "collision prevention" and pollution control, it would elevate these guidelines, in essence, into hard law instruments as opposed to their current non-binding, "soft law" status. This would be beneficial but highly unlikely given any formal amendment to

25 Private parties have formed the Space Data Association in an effort to further enhance space situational awareness.

26 However, it is a complex issue in the LOSC context whether, and under what circumstances, the "generally accepted" language in Art. 94(5) can in essence lead a party to be bound via LOSC to a particular International Maritime Organization (IMO) treaty that the party has not formally joined simply because the IMO Convention at issue has such wide-spread acceptance. *See, e.g.,* Study by the Secretariat of the IMO, "Implications of UNCLOS for the IMO," 19 January 2012, Doc. LEG/MISC.7, *available at* <www.imo.org/ourwork/legal/documents/implications%20of%20unclos%20for%20imo.pdf>. In the space context, the issue would become whether "generally accepted" could refer to soft-law instruments, and whether the UNCOPUOS guidelines adopted by 70 or so nations – basically all nations active in space – could be considered "generally accepted."

Art. VI of the OST is politically and diplomatically impossible.[27] Nevertheless, a Code of Conduct, itself "soft law," that laid out more significant duties on regulating states and that borrowed some of these concepts from Art. 94(3-5) of the LOSC could also potentially elevate, at least through reiteration and emphasis, the practical force of space debris mitigation guidelines. A Code of Conduct is currently under consideration by many of the major space powers, including the European Union and the United States,[28] so that legal vehicle for incorporating parallel duties to those found in the LOSC's Art. 94 is available.[29] Further, LOSC Art. 94(5)'s call on flag states to "take steps necessary" to secure observance with generally accepted international regulations and practices – provided those terms covered a soft-law instrument like the UNCOPUOS debris mitigation guidelines - could, if incorporated in a Code of Conduct, enhance pressure on nations to incorporate the debris mitigation guidelines into their licensing requirements for space actors under their authority.

III Law of Salvage under International Maritime Law: What Might the Space Law Regime Borrow with Appropriate Adaptations?

Space law scholars often mention that the law of salvage in international maritime law could serve as a useful legal model for the mitigation through OOS or ADR of space debris.[30] But the suggestion that salvage law could be engrafted into the outer space legal regime deserves careful analysis. Indeed, a detailed examination finds that there are many complications and pitfalls in a wholesale replication of the law of salvage from the maritime context to the situation of outer space debris. Nevertheless, there are some principles from and conceptions of the law of salvage from international maritime law that can be usefully applied to outer space debris with appropriate adaptations. In particular, the concept of liability salvage, or perhaps even better, the principle of special compensation for efforts to protect the environment, may be able to play a

27 *See, generally,* Mirmina, supra note 2. I should add amending the OST would likely be unwise and risky in the sense numerous other obligations may then be reopened and any effort to limit amendment to Art. VI would likely fail.

28 *See, e.g.,* Revised Draft Code of Conduct for Outer Space Activities, EU Council Doc. 14455/10, 11 Oct. 2010. Indeed, the revised draft does highlight in Arts. 4 & 5 the need to avoid collisions and limit space debris, so in some respects already borrows some of the concepts from LOSC Art. 94.

29 Obviously any decision by a government whether to support the Code of Conduct will depend on a variety of issues, not only its impact on space debris mitigation.

30 *See supra* note 7. Ironically, salvage law has already been applied to a space object. However, the space object was not in outer space – rather it was being carried by a barge. A salvage award of 4 plus million dollars was awarded for the rescue of barge carrying external fuel tank of NASA Shuttle in 1980's. See *Margate Shipping Co. v. M/V JA Orgeron*, 143 F.3d 976, 983 (5th Cir., 1998).

role in allowing ADR and OOS for debris mitigation (OOS-FDM) to proceed. However, space law itself would need to be adapted or modified or clarified to allow for adapted conceptions and principles from the law of salvage to play a useful role in creating a truly international market as there is little prospect of engrafting such principles through accepted interpretation methods of treaties into existing space law treaties. Smaller salvage markets could be created through domestic legislation alone, if changes to international space law are not possible.

A The Quandry for ADR and OOS-FDM under Existing Space Law

Article VIII of the Outer Space Treaty (OST) declares that the registering state of a space object "shall retain" jurisdiction and control over space objects and also states that ownership of a space object is not affected by its presence in outer space. Accordingly, it is widely thought that the state of registration has exclusive jurisdiction and control over the space object even once it becomes defunct and that ownership of a satellite, or even pieces of it if it has broken apart, continue on indefinitely. There has been no real attempt to use the language "shall" in article VIII to turn the interpretation into a purely obligatory obligation to "control" a space object – such that a defunct, de-orbiting satellite would create a violation of that obligation. Even if such an interpretation was attempted, the ownership provision would appear to prevent any vacuum from occurring such that an entity wishing to conduct ADR or OOS-FDM could still not seize the object. The ownership of a space object in perpetuity, even once defunct or broken apart, under Art. VIII is thus the first major element of the space law regime creating a dilemma for those interested in pursuing ADR or OOS-FDM.

The Liability Convention of 1972, one of the other major space law treaties existing today, provides for absolute liability of the launching state of a space object should it cause damage on Earth or in airspace. Most debris will not survive the atmosphere and thus this rule does not necessarily give incentives to the owners of debris to give permission for ADR or OOS-FDM of their debris. The Liability Convention provides a fault-based rule, in essence a negligence standard, for damage caused by one space object to another in outer space. This rule at first glance might be seen as an incentive for debris owners to allow ADR or OOS-FDM of their debris since one might assume if debris collides with an active satellite the debris owner is at fault. However, the determination of fault can be more complicated. Key facts would be how the debris was created, how long the debris was in space, was it created before or after the development of space debris mitigation guidelines by the IADC and UN COPUOS, was it tracked by the SSN, and did the satellite or space craft operator receive a conjunction warning by US STRATCOM. As of yet, there has been no case under the Liability Convention for damage to an active satellite caused by space debris.

It is important to note that the Liability Convention does not apply when a space object causes damage to another space object of the same launching state or to damage on Earth inside the territory or to nationals of the launching state. Domestic legislation and rules will apply to those situations. Nevertheless, OST

Article VIII's indefinite ownership rule combined with uncertainty under the Liability Convention as to whether a debris owner would be held liable in case of collision with an active satellite makes the prospect of ADR or OOS-*FDM on other nation's governmental or commercially owned* debris legally problematic. Hence, the calls for space law to borrow from the law of salvage in international maritime law.

B The Basics of the Law of Salvage and its Potential Application to the Problem of Outer Space Debris

The essential elements of a salvage claim, since the earliest salvage cases of the US Supreme Court addressing such claims, are the following:
"(1) there must be a *marine peril placing the property at risk* of loss, destruction or deterioration; 2) the salvage service must be *voluntarily rendered* and not required by existing duty or by special contract;[31] and 3) the salvage efforts must be *successful* in whole or in part."[32]
Immediately, several confounding issues are raised by the doctrine in the context of space debris. More specifically, ADR is not likely to fall easily within the first and third elements, and OOS-FDM will not easily fit within the second element.
In the first element, the law of salvage focuses on a maritime peril that threatens property with loss, destruction, or deterioration. The most prototypical example is a fire on board a ship threatening the ship with destruction.[33] We can imagine a satellite that has run out of fuel or has a damaged solar panel that threatens the satellite with destruction or at least a reduced life. We can subsequently envision OOS-FDM being undertaken, such as by refueling the craft or replacing damaged panels, to preserve the satellite's expected life. The lack of fuel or the damaged panel would be analogous to the fire on board a ship. Thus, OOS-FDM meets the first element conceptually. However, when we think of existing debris and remediating that debris through ADR, the first basic element of law of salvage also does not seem as if it fits very comfortably. For existing debris, again non-functional objects, they are not in peril for they are no longer useful nor valuable property-with some caveats naturally. One caveat, for example, is there are ideas to take parts (or pods) from inactive satellites that are still potentially functional and place them on cores or shells of satellites that would be launched into space. In essence, recycling or re-using the components of satellites is the idea. Nevertheless, much of the current debris is non-valuable in the sense of being no longer useful (e.g. the fractured

31 In the maritime context, some salvage does occur by contract but then it is the contract that largely governs the parties relationship.

32 *See, generally*, Thomas Schoenbaum, ADMIRALTY AND MARITIME LAW, Vol. 2 at 324 (2nd ed. 1974); *See also* Benedict, ON ADMIRALTY, Vol 3A; Martin Norris, THE LAW OF SALVAGE (1958).

33 Indeed, this was situation in perhaps the seminal Supreme Court salvage case, The Blackwall, 77 U.S. (10 Wall.) 1 (1869).

pieces of China's aging weather satellite that was intentionally destroyed by a Chinese ASAT in 2007) or due to being very dated technology (e.g. an old Russian rocket body or part thereof from the 1960's or 1970's). This more typical debris is creating peril for active satellites but there is no peril to the debris itself for it already has no value.

The most traditional conception of salvage's third element requires the salvor's efforts to be successful, or in other words, the salvor must actually recover or protect the threatened vessel. However, while OOS-FDM that restores the expected life of a satellite or extends life of a satellite meets this element, ADR, in contrast, will not lead to successful recovery or protection of the threatened property, the piece of space debris. Instead, most ADR technologies are likely to be employed in a fashion that leads to a hastened de-orbiting of piece of debris with it eventually burning up in the atmosphere. ADR technologies using a robotic arm to initially capture a defunct satellite and place in a cargo hold for a subsequent return trip to Earth are likely only to be utilized in the rare situation of a relatively new satellite or component that is both expensive and can be quickly fixed or an object that is of very sensitive national security importance.

The second traditional factor of salvage, like the first and third, also raises complications in the context of space debris, but it is OOS-FDM that creates the complications under this factor, not ADR. It is likely that salvage efforts in the form of ADR, at least in the current state of space law, will be voluntarily undertaken rather than contractually. Lots of space debris is of unknown origin, indeed a full third of the softball or larger sized objects are tracked but of unknown origin. It will be impossible to contract for ADR of this debris, and of course most of the untracked debris is also of unknown origin. Indeed, some might argue for an analogy to the "law of finds" rather than the law of salvage if debris is of unknown origin, yet adjustments from the maritime regime's version of the law of finds would be necessary.[34] At a more practical level, there may be no country in position to complain if the unknown origin debris is subject to ADR. Contractual arrangements for ADR for known debris are difficult to envision occurring since the originator of the debris may have little incentive to pay for its removal, given uncertain liability in case of collisions, unless it takes a long-term sustainability view that pushes it to act as a good citizen for its own sake and those of other users of space. Moreover, some nations may refuse to pay to have their known debris removed by others, due to other budget priorities, and/or not wanting others to test new ADR technologies that have potential military applications on their debris. In contrast, it is hard to imagine OOS-FDM occurring very often voluntarily, at least when such services initially become available. It is unlikely OOS-FDM operators would become aware of the need for service, at least the specific service required, unless contacted or informed by the operator of a damaged satellite. Further, cooperation between the OOS-FDM operator and the satellite operator would be necessary

34 For example, the "law of finds" under maritime law is disfavored and there is a presumption that government property is never abandoned in certain countries like the United States.

to achieve a conjunction between the two pieces of equipment in order to allow the OOS to occur. The degree of cooperation required will probably push towards a contractual arrangement being in place, again at least when OOS services initially become available.

C "Liability Salvage" and "Special Compensation" for Preventing Damage to the Environment

The examination of the basic elements of the law of salvage reveals a fundamental problem as applied in the space domain: Most space debris is of no value and is not facing a peril but rather creating a peril for functioning space objects. The law of salvage becomes a useful concept for ADR (and a more useful concept for OOS-FDM) *only* if it recognizes the value in protecting the owner of the space debris from third party liability and other associated costs should the debris hit a functioning space object (or, in more rare circumstances, should the debris cause damage on Earth).

If the debris was destined to cause damage on Earth (i.e. survive descent through the atmosphere), then it is clear the "salving" of the space debris would save the owner (or more specifically the owner's government, if the object was privately owned) from absolute liability, assuming, of course, the debris was destined to fall to Earth outside the territory of the owner's country. If the space debris was destined to fall inside the territory of the owner's country, the issue would not be governed by the Liability Convention, except in the rare case that citizens of a third country were injured in such a situation. If space debris was destined to fall inside the territory of the owner's country, there might be third-party liability under the domestic legal system even if, as in some major space power countries, mandatory third-party liability insurance requirements and government indemnification would take care of the first large swath of third-party liability. In this latter situation, it might be harder for the salvor of the debris to prove he saved the debris owner from liability, unless the amount of damage would be anticipated to exceed insurance and government indemnification limits. Only the more tenuous argument that the salvor perhaps saved the debris owner from higher insurance premiums or other costs would remain.

In the case of space debris destined to collide with another space object in outer space, the situation would be heavily fact dependent as to whether the salvor saved the debris owner from liability by remediating the debris. As discussed, earlier, when objects collide in space, the Liability Convention imposes a fault-based system that many would argue implies a negligence standard. For debris created in a manner inconsistent with the IADC guidelines and UN guidelines (which largely dovetail one another), there is a strong argument the debris owner could be found liable in the case of a collision with a functioning space object. Thus, in such a situation, there is a strong argument that a salvor would be saving the debris owner from third-party liability by removing the debris. Measurement of the liability avoided is difficult, of course, because it would involve predictions on the likelihood of collision between the debris and a functioning space object and the nature of the damage that would be caused.

Despite these factual complications and measurement difficulties concerning third party liability on Earth and in outer space, the concept of liability salvage is still the most promising element of maritime salvage law to be applied in the context of space debris. However, even in the maritime context, liability salvage has not found widespread support. Indeed, it was rejected in the negotiation of the 1989 Salvage Convention, a treaty laying out rules for salvage that applies to both international and domestic salvage situations, and named after the year it was finalized and signed, although it only came into effect in 1996.[35] However, the 1989 Salvage Convention recognizes the possibility for awards for preventing or mitigating damage to the environment. Indeed, while the 1989 Salvage Convention's criteria for fixing an award generally track those of the Blackwall case,[36] there is one key addition that could be quite useful if borrowed by the space law regime in the context of space debris.

Specifically, Article 13 of the 1989 Salvage Convention includes as criteria:

"(b) the skill and efforts of the salvors in *preventing or minimizing damage to the environment*;

Further, Article 14 lays out an alternative grounds for calculating an award – termed special compensation-by allowing for awards of up to 130%–200% of the costs of salvage efforts taken to protect the environment. Criteria 13(b)'s inclusion of "preventing or minimizing damage to environment" as well as Article 14's alternative grounds for calculating an award would be useful in the context of promoting ADR and OOS-FDM because the salved property would have little to no value but eliminating the debris would be considered to prevent pollution of the space environment. In short, Art. 13(b) and 14 keep incentives for salvage even when the value of the salved object is or will soon be zero. Of course, many additional complications of applying these advanced principles of salvage will arise and will require creative solutions.[37]

As mentioned earlier, the amendment of the OST or the negotiation of a new broad multilateral treaty governing space is a political and diplomatic impossibility in the near to medium term. Thus, the best chance would be for bilateral or plurilateral agreements among major space powers, although even obstacles to these may be severe, given the national security implications of OOS and ADR technology, and regulations such as the US International Traffic in Arms Regulations (ITAR) that may complicated US salvors utilizing certain ADR or OOS technologies to salve Chinese debris, and likely even Russian debris, and visa versa.[38] Agreements between strongly allied countries such as the US and European allies might still be a possible starting point.

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35 The International Convention on Salvage, 1989, available at <www.jus.uio.no/lm/imo.salvage.convention.1989/doc.html>.

36 *See id.* at Art. 13.

37 *See* Matthew Schaefer, *The Law of Salvage as a Model for Space Debris Remediation and Mitigation*, forthcoming (draft on file with author).

38 *See* Matthew Schaefer, *ITAR Complications to Space Debris Remediation*, forthcoming.

If international negotiations fail, a country particularly interested in creating incentives for its ADR and OOS operators, could pass domestic legislation allowing for liability salvage or "special compensation" in cases in which ADR and OOS is performed on space debris from its own country. However, there will be disincentives to passing such legislation as well, namely launch providers and satellite operators in that country may face increased costs vis a vis their competitors abroad.

IV Conclusion

Space law is a part of (or sub-specialty within) public international law. There was significant interplay between space law and other areas of public international law from the very beginning of space law's creation, including the borrowing of principles from the Antarctic Treaty. Comparisons and lessons from other areas of public international law can continue to benefit the space law regime. Indeed, the examination above reveals that the Law of the Sea Convention, specifically in the duties it lays out for flag states regarding vessels, and international maritime law, specifically principles of liability salvage or salvage awards based on efforts to protect the environment, may provide useful analogues, if appropriately adapted, in efforts to combat the growing problem of space debris.