

ACTIVE DEBRIS REMOVAL: MITIGATING LEGAL BARRIERS FOR PROMISING TECHNOLOGIES

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ABSTRACT

Space debris is a rising threat to the very existence of space exploration by Humankind. As private initiatives are rising, some orbits are getting more and more densely populated, creating an increasing risk of collisions, eventually leading to a production of new debris. Several international, regional and national initiatives are aiming to reduce the number of debris *ex ante* i.e., before the object is launched into Outer Space, via contractual and regulatory provisions.

Also, some breakthrough solutions now aim to act *ex post* i.e., after the object is in Outer Space. Such solutions known as “Active Debris Removal” (ADR) are very promising and could potentially provide a crucial help into cleaning the Outer Space in order to preserve its very access.

Beyond the technological challenges lays a legal one: how can a mission lawfully intercept a space debris and remove it from Outer Space? From a strict legal point of view, any object launched in space has an owner which retains such status, even when the mission is over. Nowadays, more and more objects follow a deorbiting plan or just disintegrate into the Earth atmosphere after their mission ends. However, in the specific case of ADR, such techniques would be used to remediate past situations, to intervene in case of premature total loss or if a deorbiting plan fails.

In fact, the very notion of property rights still attaches to these former space objects and current space debris. It is therefore tricky for any ADR mission to act without a clear green light from the legal department.

The purpose of this article is then to present the current legal context and some propositions to help securing such missions from a legal standpoint. The present situation shows in this regard a lack of global harmonization as space treaties never really created a legal regime for space debris. More, there is not a clear threshold to switch from a qualification of space object to space debris.

Some proposal could then appear relevant in order to help legal framework to better encompass ADR technologies and secure their development. In this regard, it is crucial to determine a widely stakeholders-approved definition of Space Debris that possibly details the criteria of such regime. Pursuant this idea, this article attempts a comparison with International Law applicable to wrecks on the Sea as well as with some relevant elements found in French Maritime Law. Then, some guidelines could be developed in order to influence sector-specific best practices, eventually leading to binding instruments. Such bottom-up approach shall specifically take into account the level of control the owner of the space object can possibly keep before a definitive loss. Moreover, such high-risk operations shall be framed within a specific liability regime, as debris are *per se* non controllable.

1 THE CONTEXT

Since the very beginning of the Space Race in the 1950s, space activities generate space debris. For decades, space objects such as satellites were let in orbit after decommissioning. Several techniques such as explosive screws were used which also caused debris to be created. In short, each space object shares a common fate: becoming a space debris.

Space debris have therefore been multiplied over the past fifty years and the situation is now critical, as collision can occur and fail an entire space mission. In the longer term, the very access to Outer Space is threatened by this environmental crisis. However, new technologies and better practices are now being developed to mitigate and eventually solve this issue.

As sustainability is becoming a keyword, stakeholders are acquiring good practice and keep implementing mitigating measures. For instance, the UN Committee on the Peaceful Uses of Outer Space (COPUOS) has adopted guidelines designed to prevent the creation of debris in Outer Space.

In-orbit servicing is a step forward in the mitigation approach as new services may help space objects to extend their life or correct failures that could jeopardize the mission. On the other side of the fight against space debris, Active Debris Removal (ADR) is another category of service except this is not about prevention but remediation. An ADR mission can help put a dead space object on a graveyard orbit or push it down the Earth atmosphere, to be eventually consumed. ADR aims to clean Outer Space from existing junks whereas mitigation measures and in-orbit servicing aim to prevent the creation of new debris.

1.1 ADR & Regulations

Outer Space exploration was originally a State-restricted affair. After Cold War and as private giants progressively emerged, the ongoing commercialization of Outer Space is influencing the way the sector is regulated. As Space Treaties are still the cornerstone of International Space Law, these instruments have not really been designed to deal with private stakeholders and current crisis such as Space Debris. In this regard, even if Space Law Principles remain relevant, new branches of Space Law are developing such as National Space Laws and sector-specific soft-law, such as space debris mitigation guidelines.

Based on this situation, it is thus possible to make a comparison with network-based industries, for instance telecommunications or energy. These industries used to be State-controlled and were progressively opened to the competition since the 1980-1990s. Law has been a crucial parameter in this transformation as these industries tend to naturally merge into monopolies given the capital-intensity and the barriers to entry. By making competition the objective of the new regulation, these sectors have been successfully liberalized in several jurisdictions around the World. The current challenge of tackling the Space Debris crisis could process a similar way. As sustainability would be the objective of debris regulation, mitigation guidelines, in-orbit servicing and self-deorbiting would be *ex-ante* measures i.e., regulations designed to implement good practice. ADR, on the other hand, would belong to *ex-post* regulations, as a correction/remediation measure. This comparison also shows the importance of getting of “bottom-up” approach regarding the Space Debris crisis, because network-based industries regulatory approach primarily involves stakeholders.

1.2 ADR & Space Law Principles

The Space Law ecosystem has been progressively established since the very beginning of the Space Race, in a Cold War era. This ecosystem is divided in two main blocks which are the International Space Law based on treaties and other international instruments, and the National Space Laws, based on statutes passed by several

States in order to regulate the sector in their own jurisdictions, according to space treaties. Whereas the first block has been quite stable, the second one is now developing, as a rising number of States is now working on passing a national space law.

The entire Space Law relates back to space treaties. The Outer Space Treaty (OST), adopted in 1967, is the first binding international instrument regulating space activities. Because of the Cold War context, the OST is mainly focused on guaranteeing peaceful activities in Outer Space, preventing weaponization and setting up a liability regime in case of an accident. Several subsequent treaties were adopted such as the Rescue Agreement (1968), the Liability Convention (1972), the Registration Convention (1975) and the Moon Agreement (1984).

Because the OST is the founding treaty of Space Law, the focus will be set on its core principles, as subsequent aforementioned treaties further developed and applied the said principles. Some of these core principles could be applied to ADR in order to enshrine this emerging technology within the international legal regime for space activities.

Freedom of access and exploration of Outer Space is the first core principle of International Space Law that can be applied to ADR. Article I of the OST states that “*Outer space, including the Moon and other celestial bodies, shall be free for exploration and use by all States without discrimination of any kind, on a basis of equality and in accordance with international law, and there shall be free access to all areas of celestial bodies*”. As Space Debris are a threat to the safety of space missions and, eventually, to the very access of Outer Space, ADR technologies and services contribute to maintain the conditions of a free access to Outer Space.

State responsibility is the second core principle applicable to ADR. Article VI of the OST establishes a general liability principle for national activities: “*States Parties to the Treaty shall bear international responsibility for national activities in outer space, including the Moon and other celestial bodies, whether such activities are carried on by governmental agencies or by non-governmental entities [...]*”. This liability principle directly involves that States shall grant authorization for any non-governmental entity willing to pursue space activities and that they also have to maintain supervision over the said activities. Thus, any ADR service performed by a private venture shall get prior authorization from the State. International Organizations are also liable under this regime, as their own international liability may be triggered as well as their Members States’. In case of ADR lead by a regional agency such as ESA, liability would then be borne both by the International Organization and its Member States. Article VII extends this liability regime to States directly

launching or procuring the launch.

The registration of space objects is the third core principle applicable to ADR. Because States are liable for space activities and objects they launch, they need to record these objects as the OST indicates in its article VIII that States “*retain jurisdiction and control over such object, and over any personnel thereof, while in outer space or on a celestial body [...]*”. Applied to ADR, this principle involves that space debris, even if they cannot be controlled anymore, are still under the jurisdiction of the Launching State.

The fourth core principle applicable to ADR is cooperation. Article IX of the OST lays the principle of cooperation and mutual assistance. Furthermore, the same article specifies the duty for States to preserve the Earth environment while conducting space activities. Even if low orbits are not within the Earth environment per se, it could be argued that a catastrophic space debris outburst may be a damage to Earth environment by extension, as access to Outer Space could technically no longer be possible for a long period of time.

Therefore, even if ADR and, more generally, the Space Debris crisis has not been foreseen by space treaties, common principles acknowledged in these instruments may be applicable to ADR as space activities but also as activities conducted to both preserve the Outer Space and Earth environments. In this regard, the notion of sustainability could be seen as a modern application of the original idea of environmental preservation. However, it is also clear that space treaties are not fully adapted to the specific legal issues of ADR, which, unresolved, could become barriers.

2 IDENTIFYING LEGAL BARRIERS

Several legal issues affecting ADR may be identified. Because ADR targets debris, the very definition of space debris is crucial. This first issue then triggers several subsequent ones such as ownership or liability.

2.1 Space Debris Definition

The notion of Space Debris is not formally defined by binding legal instruments. Several non-binding documents are dealing with this issue and propose a definition. For instance, the United Nations Office for Outer Space Affairs (UNOOSA) has adopted Space Debris Mitigation Guidelines in which Space Debris are defined as “*all man-made objects, including fragments and elements thereof, in Earth orbit or re-entering the atmosphere, that are non-functional*”. The Inter-Agency Space Debris Coordination Committee (IADC) also released its debris mitigation guidelines and uses the same definition. This definition, despite being non legally binding, shows a possible consensus on this issue.

However, because ADR is a remedial procedure, not

every space debris may be eligible for such service. In fact, the functional definition of space debris does not address the issue of suitability for ADR. In fact, are all debris qualifiable as Space Debris? Could it exist a *de minimis* threshold for non-threatening debris? Is a non-functional object but still controllable a Space Debris? The current impossibility of having a unified case law to further detail this definition shows the limit of such approach. Even if elaborating a consensual definition is absolutely necessary, maintaining knowledge of the current Space Debris situation and producing legal doctrine and soft law to help better comprehend such definition appear to be two important steps to consider.

2.2 Ownership

ADR aims to capture space debris in order to bring them back to the Earth atmosphere to consume them or put them away in a graveyard orbit. This operation of destruction shall then be approved by the owner of the space debris. In fact, even if a space object become a space debris at the end of its service or after a total loss, it legally remains a property of a stakeholder. The issue of ownership is crucial because ADR may only be performed while (i) the owner of the space debris is identified and (ii) the same owner gave its authorization. In case the owner can no longer be identified, the issues of ownership would still have to be cleared. Tracking and maintaining an updated record of space objects and their evolution into space debris is then particularly relevant to address this issue. In case tracking is not available, a potential international legal regime for ADR could use a notion of non-identified space debris or adopt a specific definition for unidentified space debris. In this regard, could the failure to maintain a record of the space object – which is a violation of International Space Law – be sufficient enough to declare *res nullius* the former space object? Going further, should the definition of space debris imply a potential loss of rights over the former space object?

2.3 Legal Nature of ADR

The determination of the legal nature of an ADR service is necessary in order to set up a contractual basis to the relation between the space debris owner and the ADR entity. This latter entity can be a public institution, a private venture or even a Public-Private Partnership. Some parameters are however critical to qualify the relation between these two parties. For instance, ADR could be a pure service, during which the contractor only provides the service to move the debris out of its current orbit. However, this could also be a potential transfer of ownership and, eventually, of liability. In this scenario, ADR is not only a service but also a transaction that involves a transfer of ownership. Moreover, and following this idea, could such transaction be qualified as an export and then fall within the scope of export control

regulations? In the event of an unknown debris, is the ADR mission an appropriation of the unknown debris?

2.4 Liability

ADR, like every space mission, is potentially risky. Insurance could be required by the Launching State for the launching operations. Also, damage might be done while in-orbit. The issue of ownership is intertwined with liability as property rights trigger liability. In case of a pure service approach, the ADR provider could have its liability strictly limited to its own operations. However, if a transfer of ownership occurs, the previous owner of the space debris cannot be liable for anything happening after the transaction.

Liability also impacts Launching States as they could potentially block ADR operations, due to the fact that their own international liability does not cease with the transaction, as per International Space Law (see. *supra*).

2.5 Financing ADR through regulation

ADR aims to retrieve space debris which are former space objects without any value (at least for the time being). Therefore, funding could be an issue. However, the current Space Debris crisis may have significant impacts on the very existence of a space industry, at a global scale. Given the huge stake, ADR could also be seen as part of an international public service, in order to preserve access to Outer Space and the pursuit of space exploration by Humankind.

Public service could then imply a specific taxation. However, taxation requires sovereignty and there is no international body with the legitimacy to claim a tax to fund ADR missions, despite the importance of such operations for the sustainable global use of Outer Space. On a national level, taxation is tricky. In fact, there is a huge risk for States to harm their national space industry if some of them were taking the initiative to collect a special tax in order to fund ADR missions. In fact, forum shopping is a risk that no space jurisdiction is willing to accept, especially at a time where New Space is taking off. Also, a decommissioning tax payable in case of loss of the space object could generate litigation and eventually forum shopping in favor of jurisdictions without specific taxation.

Alternatively, two funding mechanisms may be relevant giving the stake and the conditions of ADR. First, an international fund managed by a dedicated UN-related body could collect a contribution from Member States in order to fund ADR missions. Second, a Public-Private Partnership could help funding the project and get private ventures to invest in ADR.

3 ADR: A SEA LAW PERSPECTIVE

The High-Sea shares some similarities with Outer Space.

There is no possible claim of jurisdiction beyond the flagship of the vessel. Registration plays a crucial role and mutual assistance is a core principle of the Law of the Sea.

The comparison between Outer Space and the High-Sea is quite common and offers an interesting field of reflection. In the case of ADR, shipwreck is especially interesting to compare with Space Debris.

3.1 The Notion of Shipwreck

The UN Convention on the Law of the Sea (also known as “The Montego Bay Convention”, adopted in 1982) - which is for High-Sea what the OST is for Outer Space - does not provide any definition of a shipwreck. This situation is similar for the International Convention on Salvage (adopted in 1989). This latter international instrument only defines “vessel” as “any ship or craft, or any structure capable of navigation” (article 1b). A comparison could then be drawn with Space Debris, as the proposed definition also adopts a functional approach.

The French Maritime Law offers a more detailed definition. According to the article L. 5142-1 of the Maritime Code, a shipwreck (i) cannot stay afloat, (ii) has no crew onboard and (iii) no measures have been taken to keep it safe. By comparison, this definition could be applied to Space Debris as: a space (i) is not functional, (ii) is not responsive and (iii) is not controllable.

This comparison shows that defining a shipwreck at an international level is a complicated task that the 2007 Nairobi Convention has tried to achieve (see. *infra*). Thus, national definitions could be a relevant approach in gaining a consensus.

3.2 Toward a Space Law of Salvage?

Salvage is an ancient principle of Maritime Law which prescribes that any person who helps to recover another’s person’s ship in peril at sea is entitled to a reward commensurate with the value of the property salvaged. For space debris, the situation is somewhat different as ADR would recover non-valuable junk. However, the idea sustaining the Law of Salvage is that vessels in peril shall be saved to prevent the creation of shipwrecks. Such logic could be applied in Outer Space given the threat Space Debris is and how much ADR could help removing the most dangerous ones.

More recently, the 2007 Nairobi International Convention on the Removal of Wrecks has taken a step further in order to tackle the issue of wrecks located out of territorial seas i.e., the portion of the sea under the direct jurisdiction of a State. This treaty attempts to define shipwrecks as created “*following upon a maritime casualty*”. According to the Nairobi Convention, a maritime casualty is defined as (article 1.3): “*a collision*

of ships, stranding or other incident of navigation, or other occurrence on board a ship or external to it, resulting in material damage or imminent threat of material damage to a ship or its cargo". Thus, a shipwreck can be (article 1.4): "a sunken or stranded ship; or, any part of a sunken or stranded ship, including any object that is or has been on board such a ship; or any object that is lost at sea from a ship and that is stranded, sunken or adrift at sea; or a ship that is about, or may reasonably be expected, to sink or to strand, where effective measures to assist the ship or any property in danger are not already being taken". Interestingly, the same definition includes debris from shipwrecks and offers an approach that could be relevant as a comparison for a prospective legal regime applicable to ADR. However, the limit of the Nairobi Convention in this exercise is that it is expressly limited to States' Exclusive Economic Zone and it excludes the High-Sea from its scope, even in case of imminent hazard.

It is also relevant to notice that the 1973 Protocol relating to intervention on the high seas in cases of pollution by substances other than oil adopts several measures to be applied by States in High-Sea and despite the lack of national jurisdiction but remains extremely vague on the practicalities of such intervention: "*Parties to the present Protocol may take such measures on the high seas as may be necessary to prevent, mitigate or eliminate grave and imminent danger to their coastline or related interests from pollution or threat of pollution by substances other than oil following upon a maritime casualty or acts related to such a casualty, which may reasonably be expected to result in major harmful consequences*".

Therefore, the comparative approach of the ADR legal issues with Maritime Law shows the complexity to reach globally accepted definitions of fundamental concepts. This also demonstrates the limit of a traditional "top-down" approach for such challenge.

4 TAKEAWAYS & PROPOSALS

Several actions could be recommended in order to help dealing with the legal issues arising with ADR.

4.1 Foster Space Debris Awareness

Awareness is a crucial action, as every space object will eventually become a debris. *Ex ante* regulation aiming to mitigate the creation of space debris is indispensable, but ADR also constitutes a crucial tool to reduce the current crisis and also to intervene in case of failure of the said mitigation measures.

Because the objective of an international agreement on ADR appears – for now – to be quite difficult to complete, priority shall be put on fundamental notions such as reach a global and binding consensus on the definition of Space Debris.

Moreover, the coordination and the interconnection of existing tracking systems and databases could help prioritizing the most hazardous existing Space Debris on ADR missions.

4.2 A Dedicated Liability Regime

Here too a traditional top-down approach seems complicated to use as current space treaties are difficult to amend. A contract-oriented approach could then be studied, as the industry has now an extensive expertise dealing with risk and liabilities during space missions.

4.3 The Role of National Space Regulations

National space laws and regulations could also help fostering ADR by including provisions allowing ADR. A dedicated authorization could also be implemented, especially to deal with ownership issues and Launching States liability.

4.4 Toward a Global Harmonization?

This industrial and national effort to regulate ADR shall however not prevent the necessity to push toward a global harmonization, especially to avoid forum shopping that would negate any effort to legally support ADR.

The rising commercialization of Space offers hope for a regional and/or multilateral approach with contracts and agreements, based on the example of Artemis Accords for which seven countries are trying to define a common legal & regulatory vision for Space Resources.

A similar approach could be used for ADR and given the emergency of tacking the ongoing Space Debris crisis, it is possible to expect an important interest from a large number of stakeholders, in order to keep up with the pursuit of a Humankind's sustainable venture toward Outer Space, for generations to come.