IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Multidimensional Approach To The Problem Of Removing Space Debris

Roopa.R
Associate.Prof.,
Seshadripuram Law College
Bangalore, Karnataka

The launch of Sputnik I in 1957 proved to the world that the USSR possessed the necessary technology to launch satellites into orbit and thus would be able to use outer space in launching possible intercontinental ballistic missiles and registering of space objects became relevant for the first time shortly after the successful launch by USSR and USA in 1958.An UNGA resolution on 13 December 1958 an Ad hoc Committee was set up. The prime object of this committee was facilitating of tracking space objects for the purpose of avoiding collisions between space and aircrafts, as well as for the identification of components of space objects during the de-orbiting phase. In 1961 December 20 UN General Assembly adopted 'International Co-operation in the Peaceful uses of Outer Space' was adopted and this resolution established a voluntary system for registration of space objects in an international register. Obligation to register is linked to the concept of the 'launching state' in Article I.

A criterion for space objects to be carried on the national registry is that such objects must be 'launched' into earth orbit or beyond. The main purpose of Article VIII of the Outer Space and of the REG is to enable the identification of space object, thus allowing the identification, at any time and in each individual case, of the state that is responsible for the particular space object and thus eventually liable for damages caused by the object. This purpose is all the clearer in the case of space debris, since it produces an increased risk of damage to other functional space objects. Space debris or space wastes are non-functional objects which pose threat to functional satellites. These are artificially created waste and as of January 2019 there are 128 million bits of debris which are smaller than 1cm and 900,000 pieces of debris which are between 1-10cm. Therefore, 'non-functioning space objects' that reach earth orbit or beyond and which become de facto space debris during or immediately after launch, have to be registered. In general the question can be raised as to whether there is a natural limit of such registrations under Article VIII of the Outer Space Treaty and the REG. Debris are created deliberately for example in 2007, China used a ground-based direct-ascent missile to take out its own aging weather satellite, The Fengyun-1C. This event created an estimated 3,400 pieces of debris that will be around for several decades before decaying.

How then do we move forward so that outer space remains safe, sustainable and secure for all powers, whether big or small? This is not a task any one can carry out successfully on its own. The solutions must not only be technological or military, either. For peaceful solutions to last, and diplomacy as well as public awareness will have to be proactively forged by the world's space powers, leaders and thinkers.

Space law has come into existence only in the second half of the 20th century. When the subject was first discussed, there were some who greeted it with considerable scepticism or even derisions. At the other extreme, there were also many who entertained fanciful expectations that in space there would soon be an entirely new heavenly order, free from all terrestrial strife and governed by a matching celestial law. Today space is part of our daily life. We take for granted such things as satellite weather pictures, crackle-free transoceanic telephone conversations, satellite television with live broadcasts from the other side of the earth and even from outer space, images of the edge of the visible universe courtesy of the Hubble space telescope, global positioning navigation devices not only for ships and aircraft, but also for motor vehicles and intrepid explorers. From a more specialized angle, space has opened entirely new doors for all kinds of commercial ,industrial and scientific enterprises ,ranging from agriculture, astronomy, through communications environmental protection, fishery, the prospecting for and conservation of natural resources, medical and pharmaceutical research as well as diverse manufacturing processes relying on a gravity-free environment, to telecommunications and the management of zoological nature reserves, just to mention some. At the same time, while rocketry strategy, observation from space has also brought about a vital breakthrough in the disarmament process by providing an effective means of verification. [1]

In the present scenario, society tremendously depends on satellites for military, medicines, communication and navigation, which has resulted in space debris. There are an estimated 170 million pieces of the so-called 'space-junk' left behind after missions that can be as big as spent rocket stages or as small as paint flakes-in orbit. Man's tryst with space began by launching of SPUTNIK I in 1957 which showcased to the world that USSR possessed necessary technicalities to launch satellites into orbit and thus would be able to use outer space in launching possible inter-continental ballistic missiles.

Since the beginning of the space age, space activities that have been going on has resulted in the generation of space debris, understood as non-functional in colloquial terms 'useless' objects in outer space. Such space debris is produced during every launch by the launch vehicles (in particular their upper stages) through mission-related remainders / through the satellites themselves following the end of their 'life times'.[2]

Definition of space debris

A *Technical report on space debris (1999)* by the *Scientific and Technical Subcommittee* of the UNCOPUOS[3] uses the following definition: "Space debris are all man made objects, including their fragments and parts, whether their owners can be identified or not, in earth orbit or re-entering the dense layers of the atmosphere that are non-functional with no reasonable expectation of their being able to assume/resume their intended functions/any other functions for which they are / can be authorized". *The Inter-agency Space Debris Co-ordination*[4] employs a more concise definition: "Space debris are all man made objects including fragments and elements thereof, in earth orbit/re-entering the atmosphere, that are non functional[5]. Draft convention on Space

[1] Studies in international space law:Bin cheng:clarendon press.oxford.1997
[2] Cologne Commentary on Space Law: Vol.III: Carl hegamanns verlog: 2015:p.no.611
[3] Committee on peaceful uses of outer space
[4] IADC
[5] The Environmental Element in Space Law: Lotta Viikari:Martinus nijhoff:Leiden Boston:2008:P.no.32

Debris adopted by *The International Law Association* in1994[6] defines Space debris as "Man made objects in outer space, other than active / otherwise useful satellites, when no change can reasonably be expected in these conditions in the foreseeable future".

It is estimated that a single particle travels 22,000km/hr and a fragment or paint flake can cause catastrophe in the space. The damage caused by collision may vary from minor damage to total loss of the space craft. This debris can also disturb receiving frequency bands, radio communications of functional satellites. Debris which is quite large survives the extreme heat and invariably returns to earth impacting on the ground / in the ocean. The topic of space debris emerged at the UN level in the late 1970s. An early concern was the progressive congestion of the geostationary orbit. The looming danger of non-functional objects falling back to the earth was exemplified by the crash of Soviet Satellite Cosmos 954, which crashed in Northern Canada in 1978[7] or the Soviet Salyut 7 space station, which disintegrated over Argentina in 1991.These two incidents caused no major damage but before them there have been cases in which pieces of debris have damaged property or even health. In the 1960s, part of a US satellite fell in Cuba, damaging property and killing a cow: a serious incident occurred at sea in which Japanese sailors were injured when their ship was struck by fragments of a Soviet satellite and a German ship was hit by fragments of space debris in the Atlantic Ocean. Another problem associated with space debris is nuclear contamination which occurs due to accidental collision and explosion that create space debris and radiation.

Sources of Debris are non-functional satellites explosion, collision/degradation of space craft. When we track the usage of space craft only 7% are functional and the rest is non-functional. Functional percentage of spacecraft is shrinking every year. The most common source of space debris is on orbit break-ups: over 40% of the catalogued objects (and approximately 85% of all space debris larger than 5 centimeters in diameter) consist of fragments from break-ups in space: some 17% are Derelict rocket bodies discarded after us: and about 22% are defunct space craft: The remaining approximately 13% consist of 'operational debris' i.e. mission-related objects released during space operation.[8]

Debris can be described on spatial density depending as most debris are concentrated in Low Earth orbits (LEO) in altitudes below 2000 km above the surface of the earth. Within this region at an altitude of 900 km many objects are found, at an inclination of 98 Degrees and 82 Degrees. The Geo stationary orbit at an altitude of 35,786 km above the earth which is potently used for pivotal space applications: like Telecommunications, is less populated: less than 10% of the comprehensive population is concentrated in this orbit. The remaining debris is located in between LEO & GEO in Medium Earth Orbit, in highly eccentric orbits and in orbits above the GEO.

The cascading effect of collisions, which can result in the creation of a self sustaining debris belt around the Earth, would significantly limit access to outer space or even render it impossible. If debris mitigation measures are not fully implemented and high risk objects are not removed, the future usability of outer space is

[6] The Environmental Element in space law : Lotta Viikari:Martinus nijhoff publishers:leiden.boston:2008:p.no.33
[7] Cologne commentary on space law :vol 3:Carl Heymans Verlag 2015:p.no.619
[8] The Environmental Element in space law : Lotta Viikari:Martinus nijhoff publishers:leiden.boston:2008:p.no.36.

at risk. The concern for the future is directly acknowledged in the COPUOS SDM[9] guidelines which has remarkably observed that space debris pollution has an International character and it ranks among global problems vis-à-vis of climate change, destruction of rain forest and loss of bio-diversity.

The pollution caused by space debris grabbed the attention of International Community which culminated into developing revised standards and practices to reduce space debris. It's called 'Committee on the Peaceful uses of Outer Space' [COPUOS].The application part of the COPUOS SDM guidelines demands, in its paragraph that states should voluntarily adopt measures that ensure the implementation of the guidelines. This should be done "through national mechanisms or through their own applicable mechanism. Some states have, in fact, developed and adopted mechanisms by which they ensure that their space activities are carried out in compliance with debris mitigation requirements. An overview of these existing mechanisms is given in the 'Space debris Compendium' which emanated from an initiative of Canada, The Czech Republic and Germany. Many of these mechanisms are in compliance with the COPUOS SDM.

Types and Characteristics of Space Debris[10]

Space debris is a by product of nearly every human activity in space. Debris can be produced at any point during a spacecraft or satellite's lifetime, from its launch to beyond its functional life. Accordingly, space debris can be conceptually grouped into four different types based on its source: inactive payloads, operational debris, fragmentation debris and micro particulate debris. Inactive payloads are among the largest and therefore most dangerous types of space debris. This debris consists primarily of satellites that are no longer functional. There are currently over 3,000 payloads tracked by the U.S. Space Surveillance Network, only approximately 950 of which are active. Thus, over 2,000 payloads currently orbiting the Earth are inactive, unmaneuverable space debris. When inactive payloads collide with other objects, the results are devastating. In February of 2009, for example, a functional American commercial satellite collided with an inactive Russian satellite, resulting in 402 pieces of new orbital debris. Operational debris, in contrast, is released during satellite delivery or during the normal operation of a satellite or manned spacecraft. This type of debris includes the separated stages of launch vehicles, discarded propellant tanks and other miscellaneous hardware (like bolts or straps) released from the launch vehicle or the satellite itself. Fragmentation debris results when man-made objects break apart in space because of explosion, collision or deterioration. This is the most common type of debris in space. Scientists believe that 194 satellites have broken up in orbit. Scientists also believe that one of the greatest threats posed by space debris is that it can create a self-sustaining cascade effect in which fragmentation debris strikes other debris, resulting in a greater number of debris fragments that further crowds orbital space and continuously creates more debris.Finally, microparticulate debris is created when very small particles of matter are released into orbit, usually in the form of unconsumed propellant and gas particles. 56 Though small, microparticulate debris can still damage the outer surfaces of satellites and spacecraft. For example, a portion of the Space Shuttle Challenger's windshield was cracked by a paint chip only two-tenths of a millimetre in size, necessitating its replacement after the mission's conclusion.

[9] Cologne commentary on space law :vol 3:Carl Heymans Verlag 2015:p.no.621

[10] Jared B. Taylor, Tragedy of the Space Commons: A Market Mechanism Solution to the Space Debris Problem, 50 Colum. J. Transnat'l L. 253 (2011)

Space debris mitigation guidelines:[11]

The following guidelines should be considered for the mission planning, design, manufacture and operational phases of space craft and launch vehicle to orbital stages. The part of the space debris mitigation guidelines constitutes the core of the COPUOS SDM[12] guidelines. It contains the 7 substantive measures that limit the generation of space debris. Their implementation not only pertains to the actual operation conduct of space operation but also to the mission planning and mission design phase. These are some measures ought to be implemented at this early point in time in order to ensure effective avoidance of debris.

Guideline 1: Limit debris released during normal operations.

Guideline 2: Minimize the potential for break-ups during operational phases.

Guideline 3: Limit the probability of accidental collision in space.

Guideline 4: Avoid intentional destruction and other harmful activities.

Guideline 5: Minimize potential for post-mission break-ups resulting from stored energy.

Guideline 6: Limit the long-term presence of space craft and launch vehicle orbital stages in the Low-Earth orbit region after the end of their mission.

Guideline 7: Limit the long-term interference of space craft and launch vehicle orbital stages with geo-synchronous orbit [GEO] region after the end

Legal Hurdles[13]

In popular perception, technology is seen as an exponentially expanding industry that, much like Moore's law, continuously pushes its own boundaries. Such rapid growth is infrequently, if ever, matched by an equal evolution in the legal framework that governs it. Consequently, the controlling space law and treaties are, in many ways, hindrances to addressing contemporary problems because of their obtrusively outdated nature. In 1967, the United States signed the Outer Space Treaty (OST), broadly defining the most significant Cold War aims of what was then a bipolar celestial contest. In 1968, the United States and USSR included an Astronaut Rescue Treaty to this agreement and, in 1972, the Liability Convention was added as another addendum. In 1979, both the Registration Convention and the Moon Agreement were final caveats to this body of international law.9 Since then, governments have necessarily oriented space law around this paradigm, and the result has not always been favourable to meeting mounting contemporary challenges. First and most significantly, as of 2006, no international agreement or UN document uses or defines the term "space debris."It is impossible to address a problem that is neither identified nor institutionally acknowledged. Concededly, Article IX of the OST condemns the harmful contamination of space, though it does so in a rhetorical fashion and without mechanisms for enforcement or clear understanding of what contamination means.11 Aiding in the reluctance of states to engage

[11] Cologne commentary on space law :vol 3:Carl Heymans Verlag 2015:p.no.626
[12] Space debris mitigation
[13] https://www.researchgate.net/publication/ joshua tallis :jan-2015

in a discussion on this topic is the inclusion of Articles VI and VII in the OST. Together, these sections form a broad conceptualization of liability in which a state is not only liable for the material it launches, but is also liable for any orbital devices launched by nongovernmental entities within that state’s domestic borders.12 In 1967, when the United States and the Soviet Union were the only two nations with serious space capabilities and their respective governments provided the launch sites and overall vision for the space industry, that clause was a minor matter. Today, with space technology an ever-growing component of global commercial activities and with increased commercialization (and eventual privatization) of the space community, Articles VI and VII heap an overwhelming degree of liability on states, given the prevalence of corporations currently in the space business. Ironically, the similarly outdated 1972 Liability Convention further complicated the question of fault. This convention was an attempt to define negligence in a manner to encourage the international community to behave responsibly in space. However, for such an agreement to have any considerable impact on debris remediation, its tenets must be straightforward and enforceable. The convention produced neither. The first and most critical question to answer in exposing liability is the identification of what objects were involved in a given collision. In 1972, tracking equipment did not exist to make any meaningful technological impact on these talks. And while today US Strategic Command’s (USSTRATCOM) Space Surveillance Network has a far greater capability to detect and monitor orbital debris, this ability is far from perfect and is not universally accessible. Yet even if a claimant could accurately identify who was involved in an orbital collision, the issue of negligence still has to be determined. Legally, the last affirmative action a state takes in launching a satellite (sans standard station-keeping maneuvers) is deciding its orbital parameters; merely launching a satellite does not constitute negligence.13 Some believe that Inter-Agency Space Debris Coordination Committee guidelines, expanded International Telecommunication Union (ITU) registration, or the standard practice of boosting payloads to graveyard orbits offer avenues for assigning fault against those who do not comply with such norms in the future. But to date, no dominant rules-based order has reached global consensus.

Finally, the Liability Convention leaves us without a clear answer as to what constitutes causation. There are no rules of the road in space—no way of telling who was driving in the wrong lane or who blew a red light (only GEO slots even require registration with the ITU). Furthermore, functional satellites can often maneuver small distances. If a nonoperational piece of debris struck an operational satellite that did not jettison (move out of the way), is that contributory negligence? So far, there are no firm answers to questions like this, and consequently, catastrophic events such as Fengyun continue to pollute near earth orbits, while the international community feels no legal compulsion to act. In reality, the Liability Convention was not convened with the intention of protecting space; it was a political treaty meant to solidify key national interests in still poorly understood technical and judicial fields.14 Still, without a compelling legal (and consequently economic) incentive to patrol space,the remediation of refuse will continue to be purely a matter of lip service for most states.

For argument’s sake, let us assume states genuinely wanted to fix this problem and agreed to uniformly address every issue raised thus far. Only a handful of nations have the capability to actually remove debris from LEO, MEO, and GEO (mainly the United States and Russia). Imagine, in a joint project, that these states develop a clever mechanism for the remediation of medium- to large-sized nonoperational orbital material. Despite these efforts, according to both the OST and the Registration Convention, there is no such thing as salvage rights in orbit. Anything put into space remains the property of the entity that launched it—even if that property explodes into 5,000 pieces. It is therefore illegal to move or remove any object in space that does not belong to the launching state or state of registry—at least to do so without Permission. Article VIII of the OST, which embodies this rule, may therefore bar Russian or US efforts to clean up debris in this scenario. This is, of course, assuming states can even identify who owns a certain piece of debris, which, as noted, is not a simple task. And lest we forget, what if in the effort to clean up debris, we create more? In that circumstance, we would find ourselves back at the circular discussion on liability. As we can see, remediation of space debris meets its first major obstacle in the perplexing legal regime that makes incentivizing through liability and ownership laws ambiguous and difficult to enforce. To be sure, there are solutions being considered as pressure mounts to solve this worrisome problem. Damage-compensation funds, apportioning damages based on market-share liability, and fault-based standards for damages have all been suggested.While none has achieved a consensus, the mere fact that such matters are under discussion is a promising indication that the issue of space debris remediation is gaining ground.However, until liability, ownership, causation, rules of the road, and negligence are clarified and orbital debris is officially codified as a problem, motivation for greater action will continue to languish. This reluctance among states to interact within a maladaptive legal system surrounding the space environment, while expressed in the lethargy of international action, also finds roots in domestic political and defense considerations. Any conversation on the legislative regime cannot be disentangled from the rationale driving state actors. For many nations, reluctance on this subject is driven largely by the defense apparatus.In the United States, NASA and the Department of Defense (DOD) have historically partnered on the topic of debris mitigation and adhere to strict guidelines in an effort to help reduce space debris.

Such efforts have likewise passed the United Nations General Assembly, for simple enough reasons: everyone can agree that creating even more space junk is a bad idea. In addition, while the 2010 US National Space Policy instructed NASA and the military to pursue research and development on debris remediation, the policy lacked any timetable, rendering the instruction functionally useless. Additionally, the government has yet to seriously task any agency with actually performing any debris removal, adding to the confusion in Washington.One reason for this disinterest in remediation is a result of the types of technology space cleanup would produce. Similar to concerns over satellite maintenance craft, the ability to dock and tamper with another satellite or fragment thereof leads inevitably to issues of dual use in space technology. Dual use is a reference to the civil and military applications of a related hardware. For example, a craft that could patrol and collect small debris could similarly be tasked to de orbit components of satellites belonging to another nation or competitive entity. The DOD and its counterparts in major spacefaring nations such as Russia and China have no interest in promoting the growth of such capabilities. This is not because these agents favor orbital clutter but because space debris is so far favorable to the investment in a civil technology that invariably carries with it national security ramifications. As space trash nears critical mass, such priorities may shift. Until that time, those in favor of investment in space debris technology and legislation will continue to meet strong opposition among governments.

Technical Barriers[14]

So, what can be done about existing debris? The answer, on the hardware side, is some method of active debris removal (ADR), which is an industry moniker for "something." Recent events, such as the Chinese ASAT test in 2007 and the collision of Russian (Cosmos 2251) and American (Iridium 33) satellites in 2009, have brought increased attention (and refuse) to the topic of debris remediation. One cannot overstate how critical an issue debris has become as a consequence of these two instances. Together, they have increased trackable material by nearly one-third. In response, the technical community has been tasked, despite the immense barriers noted in the previous section, with exploring some realistic and economical ADR systems for deployment within a reasonable though unspecified timeframe. However, something seemingly as simple as requesting designs for ADR concepts is inevitably tied up in myriad technical and political considerations. This section *Remediating Space Debris* outlines some of the obstacles to technological innovation in this field,with a heightened focus on the impact of policy choices on the developing technology.Technical developments in fields that project little to no short- or medium-range economic advantages do not tend to garner private resources.Some believe government research grants should fill this gap.This belief implies that, for better or for worse, political considerations directly affect where technology in such industries migrates. The impacts of this correlation are obvious in highly politicized debates on climate change or stem cell research. Moreover, despite the lower profile,this relationship plays just as significant a role in ADR investment. Because defense concerns and legal uncertainties motivate governments to defend the status quo, no profound government push has driven technological developments. Furthermore, even should political motivations converge to produce a discernable mandate for ADR research, engineers will inevitably face constricting parameters from defense agencies concerned about dual-use applications. For example, a giant laser (an actual suggestion) designed to heat up one side of a piece of debris, causing it to collapse out of orbit, is essentially a giant ray gun. If it can deorbit a decommissioned satellite, it can just as easily disable an operational one. Furthermore, assuming the existence of positive responses from the defense community, a favorable legal climate, and supportive American political will, there remains a point of debate regarding exactly what type of ADR projects merit the limited resources made available to the Defense Advanced Research Projects Agency and NASA. Such determinations would require prioritizing either the removal of smaller debris, which aids in safeguarding existing operational satellites, or the remediation of larger debris, which contributes to the long-term stability of orbital systems.22 Arguments for the former stress the use of tight resources in addressing immediate issues. Small debris is difficult to track, and the number of individual pieces extends into the millions. Difficulty cataloguing and monitoring so much debris means that things like paint chips and loose screws present the greatest short-term threat to operational satellites. Arguments for the latter stress the projections that removing even as few as five of the highest-risk large pieces of debris can considerably stabilize the orbital environment.23 Because actors can easily catalogue large debris, such materials present a more limited immediate threat. However, as noted above, the fragmentation potential of a large piece of orbiting junk presents an outsized, long-term risk. This risk will inevitably need to be addressed, though the necessarily myopic nature of politics (and the presence of more pressing considerations) makes the seemingly simple task of removing only a handful of pieces of debris difficult. Similarly, policymakers

[14] https://www.researchgate.net/publication/joshua tallis :jan 2015

face a related choice between targeted and dragnet technologies, each posing their own benefits and issues as well.24 Dragnets are particularly useful after a catastrophe, cleaning up clusters of debris before they spread by capturing a large amount of material similar to a trawler dredging the ocean floor. However,dragnets may be as undiscerning as a dredge as well—inexact in what they collect. Targeted techniques may be more equipped to mitigate the chances of specific collisions. So, assuming all of the political,legal, security, economic, and prioritization problems can be addressed,what technology is currently available for research investment?
The first step in answering that question involves enhancing situational awareness in space. To date, only USSTRATCOM monitors space debris in anything resembling a comprehensive fashion, opening a host of ethics questions on its own. For example, is the United States obligated to warn a foreign company or country of an impending collision?However, this single monitoring task relies on aging technology to track only tens of thousands of the millions of pieces of man-made junk in space. In 2013, the US government scrapped an S-band radar system known as Space Fence, due to sequester constraints. This system was an attempt to upgrade some of the nfrastructure the joint force uses to track space debris. In June 2014, government revitalized the program, awarding Lockheed Martin a contract of nearly one billion dollars to resume work on the project. The legacy tracking system can track debris around the size of a basketball in LEO. The proposed Space Fence will be able to track debris down to the size of a baseball or smaller. This increased ability could result in the amount of catalogued debris shifting from nearly 20,000 to closer to 200,000. Yet, no matter whether Space Fence survives future cuts, any attempt at debris remediation will require that USSTRATCOM be afforded the resources to continue combing software-based predictive models enhanced by a growing ability to spotcheck more debris. Such a capability is a prerequisite to any attempts at remediation, as we cannot remove what we cannot find. Likewise,enhanced situational awareness contributes to alleviating a number of the technical issues plaguing the debate on liability.Yet, eventually, debris remediation will require the physical removal or deorbiting of space debris, and there is no shortage of proposals on how to accomplish this. One popular concept being circulated is the use of a tether, utilizing either electromagnetics or momentum exchange.Such devices usually focus on larger debris, causing such materials to drop out of LEO or flinging them into graveyard orbits above GEO—much in the way an object tied to a rope can be sent flying. The electrodynamic variant has gained prominence recently, with a $1.9 million grant from NASA to Star Technology and Research making news in March 2012.The advertised layout of their ElectroDynamic Debris Eliminator (EDDE) used a fleet of twelve crafts launched into LEO,working in unison to grab debris and drag it to short-lived orbits before cascading out of circulation. The company, which has received other government grants in the past, projected that a fleet of this size could conceivably remove all current LEO trash over two kilograms within seven years.28 Consequently, while this is a targeted system carrying with it the benefits of accuracy and control, it is designed to choreograph in such a manner that it produces the long-term benefits of a dragnet approach as well. Whether it can truly keep up with the natural increase of debris, whether deorbited material runs the risk of reaching the surface,and whether such a large and mobile fleet further increases the chances of collisions are questions still needing to be answered, leaving this regiment one among a host of uncrowned contenders for the title of panacea. It joins the ranks of lasers and harpoons in the ever-growing club of designs vying for a slice of the inevitable windfall to be made from a likely crisis. While just one example, the EDDE demonstrates the complexities involved at every level of technical development and the associated costs for even nonoperational prototypes.Space is an incredibly hostile

environment. No atmosphere, high radiation levels, extreme temperatures, and the remote aspect of operations all make remediation a technical issue of the highest complexity.Additionally, with costs so high, outcomes so uncertain, priorities so ambiguous, and technologies still untested, active debris removal will continue to linger at the mercy of political whim. Only after such uncertainties are settled can the arduous process of technical trial and error begin.Space cleanup will not be a quick fix, and scientists concerned about the immediacy of the crisis will undoubtedly continue to see solutions pushed to the horizon until those who control the flow of funding are persuaded to make the necessary political and economic investments.

Finally, any discussion of the role of commercial aerospace cannot ignore the reality that private industry is a growing segment of the launch and payload market. NASA increasingly relies on commercial partners (Orbital Sciences Corporation and Space Exploration Technologies Corporation [the latter more commonly referred to as SpaceX]) to meet its resupply obligations for the International Space Station. The Boeing Company, Sierra Nevada Corporation's Space Systems, and SpaceX are also in competition to provide commercial American access to LEO, a capability the United States has lacked since the termination of the shuttle program in 2011. SpaceX announced in August 2014 that it had selected Brownsville, Texas, as the site of a private commercial spaceport,where the company intends to conduct upwards of a dozen commercial launches annually. With these developments as a backdrop, it is obvious that private corporations cannot simply look at space remediation as an industry cash cow. Aerospace companies must be included in a regime that fairly distributes the responsibilities of debris prevention and remediation in a way that meets their role in the modern system. Updating the Liability Convention could provide one framework with which to help expand the international legal and financial responsibilities of commercial launch companies. International bodies such as the International Telecommunications Union (a United Nations affiliate) offer yet another avenue within which policy makers can discuss this decidedly multinational issue. However, no matter the method for addressing the rights and responsibilities of private companies, any broader discussion of the legal and technical barriers to space debris remediation must recognize this is no longer solely a governmental issue.

Conclusion

Mariba Jah[15] makes a co-relation of space with that of driving a vehicle in mist / for not aware of around us. Ben Greene[16], reiterated the severity of space debris in his statement that "Catastrophic avalanche of collisions which could quickly destroy all orbiting satellites is now possible", noting that more collisions were creating extra debris

The observations made by experts are a wake up call to all the nations. It is now or never situation which is alarming. We are being selfish only to make use of the space for our needs and not clear the clutter and the mess that we have generated. Had we had a sign of any life / human being like a creature on space we would have been bombarded with plethora of cases for encroaching upon their right to pollution free environment and for making their life miserable. If we cannot declutter the clutter we have created, we have no Right to clutter. It is

[15] university of Texas, space debris expert
[16] Head of Space Environment, Research centre

time to stop horrendous generation of debris. The Researcher thinks that Polluters pay policy should be strictly adhered to like in the cases of environmental pollution.

We worship Sun, Moon and other celestial bodies and we seek permission of mother earth to step on her. Our obeisance should not only be in prayers but also in deeds as we are horrendously polluting outer space.