SPACE DEBRIS NEGATIVE

Inherency

The United Nations already has well-established guidelines for international cooperation on mitigating space debris. They should continue to lead on the issue of removal instead of having it become a US-leadership policy.

New efforts have emerged from many nations to reduce their pollution of space as well as other important steps such as increasing in cooperation on tracking and early warning systems.

Harm/Advantages

Many experts believe the threat of space debris is exaggerated. Hardly any money has been invested in clean-up technology a sign that even space experts don't believe the threat is clear an present.

Dr. Kessler himself places the threat at being at least decades away and others say we have plenty of time to act. Some experts give us hundreds of years before the orbital belt becomes unusable. Over that time cheaper solutions may develop than those we can envision today. We may also develop alternatives to orbiting satellites during that time. If one satellite is destroyed every 15 years, which is one projection of the rate, replacing that satellite is probably far less expensive and effective than active debris removal.

Solvency

There remain substantial technical, economic, political and legal barriers to developing, deploying and operating active debris removal systems. Most solutions are not technologically feasible yet. It's also not clear that even with strong U.S. leadership we could convince other countries to do their share.

Both large and small objects represent threats for different reasons requiring a different solution for each debris size, increasing the complexity, technical challenges and expense. Making contact with the debris to remove it also represents a risk in collisions creating more debris.

Disadvantages

Space debris solutions would also be extremely expensive to develop and deploy, linking to the Spending DA.

New spending on cleaning up space debris "when so many problems exist on earth" would be unpopular and controversial and therefore link to the Politics DA.

One of the primary problems with a debris removal system is that other nations would have no way to distinguish a removal system from a military program. The same technology that could nudge or catch a piece of debris would be identical to one that could nudge or catch a Chinese military satellite. If the plan encouraged programs by other nations, the US would be faced with this uncertainty as well. Space debris removal is basically an anti-satellite weapon.

Counterplans

One counterplan would be to study the problem of space debris, and how to build an international cooperation regime before we started actually using active debris removal. If we don't know the best approach yet, we should research first to see what the best, if any, solution there is that could be worked on jointly and safely with other nations. Such a research program is already underway.

If the affirmative plan does not include international cooperation, the negative can argue that a lack of cooperation would raise suspicion and ultimately doom the project. The negative might propose an alternative that incorporated cooperation.

SPACE DEBRIS DA

Inside your Space Debris affirmative file is evidence that can be used to put together a Space Debris DA that you can run against other affirmatives. The basic argument is that space debris is a problem that is under control right now but the affirmative plan makes it worse.

There are two different link arguments you would make, depending on the affirmative plan. If the affirmative plan increased the number of launches, like the Space-Based Solar Power affirmative, that would increase space debris because each launch causes more debris, plus the program in space to assemble the satellites and receptors would cause debris.

A second type of link argument is that the plan would prevent the type of international space cooperation necessary to address the growing debris problem. This is a link you could argue against the U.S. Leadership affirmative because it would undermine international space cooperation with nations like China. The evidence that says cooperation is necessary to solve the debris problem is very good. The reason for that is because many nations contribute to the debris problem so no one nation will want to take expensive steps to solve the problem unless it knows that other nations will do so as well.

INHERENCY ANSWERS

Karl Inderfurth, Prof. GWU, Raja Mohan, Libr of Cong chair in foreign policy, 11.20.11

[www.ft.com/cms/s/0/87161d80-d794-11de-b578-00144feabdc0.html]

Fourth, space governance. The US and India should work to forge a consensus on limiting space debris, improving “space situational awareness” for avoiding hazards, and ensuring unhindered operation of the space assets of all nations. Creating a new voluntary code of conduct in outer space could mark the start of an effort to bring order to the global commons.

Nicholas Johnson, Chief Scientist for Orbital Debris, NASA, 2010

[Orbital Debris: The Growing Threat to Space Operations, p.8]

Although not rising to the status of an international treaty, the UN space debris mitigation guidelines are recommended for implementation via national procedures. For example, the UN guidelines are compatible with the U.S. Orbital Debris Mitigation Standard Practices, which are implemented for government-sponsored space missions through directives of NASA and the Department of Defense and for commercial space operations through the regulations of the Department of Transportation, the Federal Communications Commission, and the Department of Commerce. Several other nations have invoked similar, non-voluntary orbital debris mitigation requirements.

<u>HARM ANSWERS</u>

Dave Baiocchi, National Defense Research Institute, RAND, 2010

[Confronting Space Debris, RAND Publication, p. 62]

The current lack of private (nongovernment) funding toward debris remedies is particularly telling. Today, the majority ownership of operational space assets (as a percentage of the total operational population) has shifted from government to commercial industry.2 For this new majority of commercial stakeholders, “the imperative to create shareholder value entails that any investment in a technical system be guided by its value creation potential” (Brathwaite and Saleh, 2009). In other words, if debris was deemed to represent an unacceptable risk to current or future operations, a remedy would already have been developed by the private sector.

Donald Kessler, Nicholas Johnson, retired senior NASA Scientists, February 6, 2010

[The Kessler Syndrome: Implications to Future Space Operations, American Astronautical Society, Conference, AAS 10-016 p. 2]

A segment of the Japanese animated TV series *Planetes*,2 set in the year 2075, is an example of a popular definition of the Kessler Syndrome that includes both factual and exaggerated com- ponents. While an episode appropriately defines the Kessler Syndrome as the cascading of frag- ments from collisions breaking up other intact objects at an increasing rate, it goes on to say that, once initiated, “.... billions of other pieces [would be generated] in a very short time [and] the Earth would be surrounded by debris .... completely cut off from space.” In general, collisional cascading is a slow process, but very much depends on the population density and size of the ob- jects in orbit. Current population densities would require decades to produce a significant change in the small debris environment, and much longer to approach a condition where the Earth might be “completely cut off from space”.

<u>HARM ANSWERS</u>

Leonard Davis, former editor, Ad Astra and Sapce World Magazine, May 9, 2011
[http://www.space.com/11607-space-junk-rising-orbital-debris-levels-2030.html]
"There is a good chance that we may have to eventually abandon all active satellites in currently used orbits," (Marshall) Kaplan (orbital debris expert at Johns Hopkins University Applied Physics Laboratory) said. "One possible scenario for the future is that we may phase out this generation of spacecraft while replacing them with a brand-new infrastructure of low-orbiting constellations of small satellites, each of which partially contributes to collecting desired data or making communications links." These constellations could be placed below 370 miles (600 km), thus avoiding the debris issue. "Such a new infrastructure could be developed over the next 20, 30 or 40 years," Kaplan said. "We should have plenty of time to make the transition, so let's use it wisely.

Leonard Davis, former editor, Ad Astra and Sapce World Magazine, May 9, 2011
[http://www.space.com/11607-space-junk-rising-orbital-debris-levels-2030.html]
The good news is that no immediate action is necessary in terms of removing debris objects, (Marshall) Kaplan (orbital debris expert at Johns Hopkins University Applied Physics Laboratory) advised, as experts estimate that the situation will not go unstable anytime soon.

SOLVENCY ANSWERS

Megan Ansdell, Space Policy Institute, GWU, Spring 2010
[Journal of Public and International Affairs, Princeton, vol 21, p 15]
There are substantial technical, economic, political, and legal barriers to developing, deploying, and operating active debris removal systems. Many current concepts rely on unproven technology, which means they will require substantial time and money to develop and deploy. The quantity of time and money required will vary with each concept, and detailed estimations are not publicly available because of the nascent state of the field. However, as a rough point of reference, it costs around $10,000 per kilogram to launch anything into orbit, making the cost of merely launching many of the aforementioned systems on the order of millions of dollars. Moreover, flagship missions at NASA, depending on their size, take five to ten years to plan, develop, and launch.

Megan Ansdell, Space Policy Institute, GWU, Spring 2010
[Journal of Public and International Affairs, Princeton, vol 21, p 15]
There is also a lack of clear policy on both national and international levels. Space-faring countries and the United Nations have only adopted mitigation guidelines and have not cited the development of active debris removal systems as part of their space policies. Moreover, there has been a lack of discussion about what entity is responsible for financing and operating these systems. This is a complicated issue as some nations have created more debris than others, yet all space-faring nations and users of satellites services would benefit from space debris clean up.

Jon Cartwright, Nature News, March 15, 2011
[http://www.nature.com/news/2011/110315/full/news.2011.161.html]
All the experts in space debris contacted by Nature said that the new proposal is feasible, but still has problems. "It'll be ineffective against dense objects that are too heavy to move," says William Priedhorsky of Los Alamos National Laboratory in New Mexico. "To use a medical analogy, they propose not to cure the disease, but to manage it."

SOLVENCY ANSWERS

New Scientist Magazine, September 15, 2010

[http://www.newscientist.com/article/mg20727772.300-space-junk-hunting-zombies-in-outer-space.html]

Initially the temptation might be to bring down as much as we can, but this will cost. "It will be so expensive to remove satellites from orbit that you will have to target which ones you want to take down," Lewis says. He has investigated a number of approaches that aim to identify the most dangerous space junk. The most obvious strategy might be to target the biggest objects, but Lewis's analysis shows that this may not be best. Just because something presents a large target does not mean that it would imperil other satellites. It may be that a smaller defunct satellite in a particular orbit presents more danger to a greater number of live craft.

J.-C. Liou, NASA Johnson Space Center, 2011

[Advances in Space Research, volume 47, p. 1876]

Orbital debris is a problem for all space-faring nations. The international community must first reach a consensus on the instability problem of the LEO debris environment. The next step is to determine if there is a need to adopt ADR for environment remediation, and then establish a balanced timetable for implementation. Just because the population will increase by 60% in the next 200 years does not mean ADR is imminent. The cost of losing and replacing one operational satellite approximately every 15 years may be affordable and the resulting damage to the environment may be acceptable in the short-term.

Duncan Graham-Rowe, The Sunday Times, may 28, 2010

[http://www.timesonline.co.uk/tol/news/science/eureka/article7139037.ece]

How you define the point at which Earth’s orbit will become unusable very much depends on your perception of what risks are acceptable. From NASA’s perspective, there is still plenty of time. “We’re talking about hundreds of years of doing nothing before it gets to be a serious issue,” says Johnson.

SOLVENCY ANSWERS

Nicholas Johnson, Chief Scientist for Orbital Debris, NASA, 2010

[Orbital Debris: The Growing Threat to Space Operations, p. 7]

On the other hand, over 99% of the risk to operational spacecraft from collisions with orbital debris comes from objects too small to track on a routine basis, *i.e.,* smaller than 10 cm. Hence, only an improvement in the orbital debris environment itself can dramatically reduce the risks to operational spacecraft.

New Scientist Magazine, September 15, 2010

[http://www.newscientist.com/article/mg20727772.300-space-junk-hunting-zombies-in- outer-space.html]

Then there are the legal issues around space debris. Under maritime law, anyone can remove an abandoned ship without the owner's permission. Not so for space vehicles, as stipulated in the 1967 Outer Space Treaty. "Once you put it up there, it is yours for life," says James Dunstan, a lawyer specialising in issues to do with space and founder of Mobius Legal Group in Washington DC. So the US may not remove a Russian satellite from orbit with impunity, even if that satellite were completely dead and presenting a danger to working spacecraft.

J. Walter Faulconer, Strategic Space Solutions, 2010

[Space Policy, volume 26, pp. 143-151]

Some suggest the USA is an unreliable partner because its political processes and tradition of biennial and quadrennial elections bring uncertainty to international agreements. For example, in 2004 President George W. Bush unveiled his Vision for Space Exploration which put a near-term emphasis on returning humans to the Moon. Inter- national partners, especially in Europe did not immediately embrace this policy because they were more interested in performing Mars missions. However, after four years of international workshops, bilateral meetings, then intense hectoring and haggling, a collective “global vision” was forged with prospective partners, especially ESA. The new global vision outlined important roles for the partners to return to the Moon and reinvigorate lunar exploration. ESA worked to cajole its members to program funds to support the Vision. Then, just as ESA was announcing that its membership had synched its planning and programming roadmap to match the Vision’s, the USA, led by a newly elected internationalist president, announced interest in a radically different plan, that recently identified by the Augustine committee. The USA is now in the process of abandoning the Vision’s “lunar base” concept and moving to a “flexible path” to manned space exploration. The change has devastated the ESA partners. Similarly, about-turns and difficulties have been experienced in collaborative work on Russian rocket engines following the collapse of the USSR.

Solvency Answers

J. Walter Faulconer, Strategic Space Solutions, 2010
[Space Policy, volume 26, pp. 143-151]
Designing and manufacturing increasingly interoperable plat- forms, performing cooperative planning, and executing satellite operations are complicated by U.S. law and policy that imposes controls on the release of sensitive technologies and operations. Indeed, important technologies and information relating thereto may be determined by the US government to be non-releasable, even to allies and close partners. This is not just a US phenomenon; other nations have their own laws and policies that clamp down on technology transfers and specific relations with other nations.

J. Walter Faulconer, Strategic Space Solutions, 2010
[Space Policy, volume 26, pp. 143-151]
Important portions of US releasability law and policy arise out of the Arms Export Control Act (AECA). It governs the sale and export of defense articles and services and related technical data, and serves as part of a statutory scheme to ensure compliance with technology control regimes that seek to slow the proliferation of missile and other technologies used to deliver weapons of mass destruction. Designated controlled articles, technologies and services are found in the U. S. Munitions List (USML), which is contained within the ITAR.

J.-C. Liou, NASA Johnson Space Center, 2011
[Advances in Space Research, volume 47, p. 1872]
From the projected increase of the future LEO debris population, a common-sense approach would argue for a timely implementation of ADR for environment remediation. However, the expectation that matured technologies will be available to allow for routine ADR operations as early as 2020 may be too optimistic. A simple comparison study was made to quantify the effect of different ADR implementation timetables. The results are summarized in Fig. 9. The middle curve is the projected population growth based on an ADR rate of five objects per year, starting from the year 2060. The average numbers of collisions predicted by the three scenarios, from the top to the bottom curves, are 47, 32, and 25, respectively. The comparison indicates moving ADR implementation from 2020 to 2060 would lead to 7 more collisions and about 2000 more objects in the environment for the next 200 years.

<u>SOLVENCY ANSWERS</u>

Brian Weeden, Secure World Foundation, February 2011
[Space Policy, volume 27, pp. 38-77, February 2011]
Active removal of large space debris objects requires different technologies and techniques compared with removal of small debris objects. Given the likelihood of limited funding for debris removal operations, it will probably be necessary to prioritize removal of one category over the other in the near term.

Brian Weeden, Secure World Foundation, February 2011
[Space Policy, volume 27, pp. 38-77, February 2011]
Within the categories of large or small objects, there are additional arguments over which objects should be prioritized for removal. This is an important consideration to maximize the benefit of costly ADR operations. The more massive an object is, the greater the amount of debris it can generate if involved in a catastrophic collision. Thus, several prominent space debris scientists argue that mass times collision probability (MPc) is the best metric for determining which large debris objects should be removed. However, there are two concerns with this approach. The first is the calculation of collision probability, which can vary depending on the model and technique used and thus can be open to debate.

Brian Weeden, Secure World Foundation, February 2011
[Space Policy, volume 27, pp. 38-77, February 2011]
All ADR techniques require some level of interaction with a space debris object, and this poses inherent risks. The harsh space environment can degrade the materials and structures of objects, making them fragile to physical contact or sudden acceleration. Debris objects such as rocket upper stages or spacecraft may have residual fuel or energy sources which could explode if disturbed. Even for benign debris objects, ADR requires precision tracking and orbit estimation to enable either rendezvous or targeting. Rendezvous operations, and in particular uncooperative rendezvous, are complicated procedures made more difficult by their remote nature.

<u>SOLVENCY ANSWERS</u>

Duncan Graham-Rowe, The Sunday Times, may 28, 2010

[http://www.timesonline.co.uk/tol/news/science/eureka/article7139037.ece]
Johnson believes it may be time to think about how to remove junk from space. But that is a difficult proposition. Previous proposals have ranged from sending up spacecraft to grab junk and bring it down to using lasers to slow an object's orbit to cause it to fall back to Earth more quickly. Given current technology, those proposals appear neither technically feasible nor economically viable, Johnson admits.

Duncan Graham-Rowe, The Sunday Times, may 28, 2010

[http://www.timesonline.co.uk/tol/news/science/eureka/article7139037.ece]
One thing that seems certain is that regardless of which organisation takes on the salvage operation, it will only go after the big stuff. And that will leave a gaping hole in the defence against space debris. Although it makes perfect sense to try to remove large objects that can do significant damage, these represent a small percentage of the total debris.

DA LINKS

Space News September 25, 2009

[http://www.spacenews.com/civil/orbital-debris-cleanup-takes-center-stage.html]
William Ailor, principal director of the Aerospace Corp.'s Center for Orbital Reentry and Debris Studies in El Segundo, Calif., said orbital debris mitigation presents a commercial opportunity for enterprising firms offering satellite repositioning or debris removal services. But as Rouge and others pointed out, differentiating between a debris removal system and an anti-satellite capability could be a thorny issue. As Ailor put it: "The idea that a debris removal system is operated by one country … goes up and removes something that is owned by another … that's going to be a touchy issue." Klinkrad agreed. "I guess the debris removal system has the potential to be an anti-satellite [system] if you don't ask the owner if he wants the spacecraft to be removed," he said.

Megan Ansdell, Space Policy Institute, GWU, Spring 2010

[Journal of Public and International Affairs, Princeton, vol 21, p 16]
Another major concern is the similarities between space debris removal systems and space weapons. Indeed, any system that can remove a useless object from orbit can also remove a useful one. There is an extensive and ongoing debate over space weapons, and in particular how to define them (Moltz 2008, 42-43). As the decades-long debate has failed to even produce a clear definition of the term, it will be nearly impossible to actively remove space debris without the use of devices that could be classified in some way as potential space weapons. Thus, openness and transparency will be an important element in the development, deployment, and operation of any space debris removal system so that it is not seen as a covert ASAT weapon.

Jon Cartwright, Nature News, March 15, 2011

[http://www.nature.com/news/2011/110315/full/news.2011.161.html]
Scientists in the United States have devised a new way to avoid collisions among space debris, and possibly even reduce the amount of debris in orbit. The method uses a medium-powered, ground-based laser to nudge the debris off course — but some are concerned that the laser could be used as a weapon.

DA LINKS

Jon Cartwright, Nature News, March 15, 2011
[http://www.nature.com/news/2011/110315/full/news.2011.161.html]
Scientists at NASA have considered using a ground-based laser to mitigate debris collisions before. However, in their 'laser broom' concept, a powerful, megawatt-class laser would vaporize the surface of a piece of debris that is heading for another, causing the debris to recoil out of harm's way. But critics argued that the laser could be used as a weapon, as it could easily damage an enemy's active satellites. Indeed, both the United States and China have in the past 15 years been accused of testing the ability of ground-based lasers to 'dazzle' satellites and render them inoperable.

Jon Cartwright, Nature News, March 15, 2011
[http://www.nature.com/news/2011/110315/full/news.2011.161.html]
And some are concerned that the laser could still be used to push enemy satellites out of orbit. Christophe Bonnal, a debris expert at the French space agency CNES, doesn't buy the researchers' claim that the laser's power would be too low for anti-satellite uses. "Let's be logical," he says. "If the power is low, you'll have no effect on the debris."

Brian Weeden, Secure World Foundation, February 2011
[Space Policy, volume 27, pp. 38-77, February 2011]
Several techniques for ADR are technically plausible enough to merit further research and eventually operational testing. However, all ADR technologies present significant legal and policy challenges which will need to be addressed for debris removal to become viable. This paper summarizes the most promising techniques for removing space debris in both LEO and GEO, including electrodynamic tethers and ground- and space-based lasers. It then discusses several of the legal and policy challenges posed, including: lack of separate legal definitions for functional operational spacecraft and non-functional space debris; lack of international consensus on which types of space debris objects should be removed; sovereignty issues related to who is legally authorized to remove pieces of space debris; the need for transparency and confidence-building measures to reduce misperceptions of ADR as anti-satellite weapons; and intellectual property rights and liability with regard to ADR operations. Significant work on these issues must take place in parallel to the technical research and development of ADR techniques, and debris removal needs to be done in an environment of international collaboration and cooperation.

DA LINKS

Brian Weeden, Secure World Foundation, February 2011
[Space Policy, volume 27, pp. 38-77, February 2011]
However, the term "space debris" does not appear in any of the treaties which form the foundation of international space law, and there is no clear legal distinction between a functional satellite and non-functional space debris. Under the existing legal regime, both are considered to be space objects. This non-distinction presents a barrier to removal in that there can be disagreement between states over the status of an object. A large satellite could be non- functional for years or decades in a crowded orbit and thus be considered by some a prime candidate for removal, but to the launching state it could represent a potential backup or hibernating capability.

Brian Weeden, Secure World Foundation, February 2011
[Space Policy, volume 27, pp. 38-77, February 2011]
The second concern is a political one: under this metric, almost all the highest priority objects are defunct satellites and large rocket bodies placed in orbit by Russia. Thus, without international agreement on the technique used to determine the priority of objects selected for removal, adopting this method could lead to the perception that the objects are being selected for removal based on political motivation. Such motivation could be to label certain states as "bad actors" to achieve ulterior geopolitical ends, justify intelligence gathering, or sabotage missions under the cover of debris removal.

Brian Weeden, Secure World Foundation, February 2011
[Space Policy, volume 27, pp. 38-77, February 2011]
Lasers fired into space for ADR present a special challenge. Although none of the laser ADR concepts utilize "weapons-grade" lasers that could destroy a spacecraft, accidental illumination of spacecraft by low power lasers could still damage or degrade optical sensors. The US military currently has procedures in place that require all Department of Defense (DoD) lasers being fired into space to register with a Laser Clearing House (LCH). The LCH screens these DoD laser firings against the satellite catalog and determines if they will pose a danger to spacecraft. Wide-scale laser ADR activities will doubtless involve a number of laser sites around the globe and hundreds of thousands of firings into orbit, especially if the objective is to remove a significant fraction of the more than 500,000 pieces of orbital debris larger than 1 cm. LCH procedures will need to be developed and implemented to ensure these laser firings do not endanger spacecraft, and, perhaps more importantly, to assuage satellite operators' concerns.

DA LINKS

Brian Weeden, Secure World Foundation, February 2011
[Space Policy, volume 27, pp. 38-77, February 2011]
An increasing number of states utilize spacecraft in Earth orbit for national security purposes, and over the past 50 years space has played a significant role in international security and stability. These important missions include ballistic missile launch detection and warning and treaty verification. An increasing number of states are also using space capabilities to augment their military power through satellite communications, precision navigation and timing, and intelligence collection. Thus, many states view interference with their space assets or capabilities as serious national threats. Many of these threats come in the form of anti-satellite (ASAT) capabilities, which can be used to deceive, deny, degrade, disrupt or destroy space capabilities.

Brian Weeden, Secure World Foundation, February 2011
[Space Policy, volume 27, pp. 38-77, February 2011]
Although ADR operations are not inherently ASAT activities, many of the technologies and techniques which are candidates for ADR operations could also be used to damage or destroy a space- craft. In the past, some of these techniques have been included in ASAT programs, although most have not made it past the theoretical stage. The development of ADR technologies and techniques by one state, particularly in classified programs, could be interpreted by other states as development of ASAT capabilities. This could prompt those states to develop their own ASAT capabilities or pursue other mechanisms to counter the perceived threat, which could in turn lead to an arms race or instability in the space domain.

DA LINKS

Brian Weeden, Secure World Foundation, February 2011
[Space Policy, volume 27, pp. 38-77, February 2011]
Removal of debris objects raises significant concerns with regard to intellectual property rights
Several ADR techniques require close approach or orbital rendezvous between a removal spacecraft and the target debris object. These techniques also require characterization of the target debris object to determine stability, spin state, structural integrity, and potential methods and points of attachment. This characterization of a debris object that is a non-operational spacecraft or a spent rocket stage could reveal patents, trademarks, or trade secrets with regard to materials science, design, or payload configuration. Divulging these intellectual property items to the third party that is performing the removal could be a major concern for the debris object's Launching State. The third party performing the removal could see the potential economic value of this intellectual property as part of their business model for doing the debris removal. If space debris objects are removed and either re-used in orbit or returned to the surface of the Earth, this could cause additional concerns. Without development of some version of maritime salvage law for outer space, the legal issues regarding intellectual property could scupper many of the most promising economic incentives for commercial ADR operations. This could stifle innovation and increase costs, reducing the likelihood that the large-scale ADR operations become a reality.

Brian Weeden, Secure World Foundation, February 2011
[Space Policy, volume 27, pp. 38-77, February 2011]
Actual ADR operations in orbit could also be a significant source of concern. Many states lack the SSA capacity to determine what is happening in orbit. Even among those states which do possess some SSA capacity, it can still be difficult to determine the exact cause of a spacecraft failure or malfunction. Thus, ADR operations carried out unilaterally by one state or covertly could create misperceptions and mistrust that could lead to instability, and potentially to conflict.

STUDY COUNTERPLAN

Dave Baiocchi, National Defense Research Institute, RAND, 2010
[Confronting Space Debris, RAND Publication, p. 3]
The Defense Advanced Research Projects Agency (DARPA), within the context of the Catcher's Mitt study, is in the preliminary stages of investigating potential technical solutions for remediating debris.3 This investigation is a critical step because even the most rudimentary cleanup techniques will require significant research and field testing before they can be successfully implemented. In addition, future path- finder missions will require extensive resources, and the U.S. government will need sufficient justification before pursuing these programs.

Nicholas Johnson, Chief Scientist for Orbital Debris, NASA, 2010
[Orbital Debris: The Growing Threat to Space Operations, p. 9]
Since 2006, the International Academy of Astronautics has been conducting a special study on different techniques to remediate the near-Earth space environment. In December 2009 NASA and the Defense Advanced Research Projects Agency (DARPA) co-sponsored the first international conference on orbital debris removal. Technical proposals for removing orbital debris, both small and large and in low or high orbits, were discussed, as were the related economic, legal, and policy challenges associated with such an undertaking. Whereas some promising concepts have been offered, the magnitude of a program to remove debris from orbit remains considerable, and significant near-term solutions are not anticipated.

COOPERATION KEY

Brian Weeden, Secure World Foundation, February 2011

[Space Policy, volume 27, pp. 38-77, February 2011]

Roughly one-third of the space debris currently in orbit is owned by the USA, one-third by the Commonwealth of Independent States (Russia), and one-third by the People's Republic of China. Thus, under international law, unilateral ADR activities by any one of these states would only be able to remove a portion of the orbital debris threat. It is possible that, with proper prior consultation, a third party could obtain permission from the Launching State to remove a debris object. However, a protocol for doing so does not currently exist and would need to be developed.

Brian Weeden, Secure World Foundation, February 2011

[Space Policy, volume 27, pp. 38-77, February 2011]

It is left to others, historically governments and militaries, to develop SSA capabilities to track objects in space and develop and maintain catalogs of their positions. The US military maintains the most complete catalog of space objects, which currently contains over 16,000 entries of objects generally larger than 10 cm in size. However, there are 5000 or more additional objects tracked by the US military which are not included in the catalog. Entry into the US satellite catalog requires that an object be tagged to a specific launch event. That has not been done, and would be very difficult and time-consuming to do, for these additional tracked but un-cataloged objects, and practically impossible for the more than 500,000 pieces of orbital debris down to 1 cm in size.

Brian Weeden, Secure World Foundation, February 2011

[Space Policy, volume 27, pp. 38-77, February 2011]

There are many different entities that track space objects and maintain various catalogs. The US and Russian militaries currently maintain the most complete catalogs. ESA uses space surveillance data from several European radar and optical sensors, as well as data from the USA and Russia, to maintain a partial catalog of geosynchronous objects. The International Scientific Optical Network (ISON), consisting of more than 20 observatories in 10 countries, also maintains a catalog of deep space objects. The Astronomical Institute at the University of Bern (AIUB), maintains a catalog of high area-to-mass debris objects in deep space orbits. None of these catalogs is exhaustive, and there are discrepancies in the numbers of debris objects, names, and orbits between them. Thus, a single, reference catalog that can be used to determine which space objects should be removed does not exist, should there be an agreed-upon metric for choosing.

COOPERATION KEY

J. Walter Faulconer, Strategic Space Solutions, 2010
[Space Policy, volume 26, pp. 143-151]
International civil space cooperation is admired as a lofty and worthy goal, but space program managers confront a far different reality from the diplomats as they direct such efforts as described in Table 2. Hopes for cooperation can soon be overwhelmed by competing interests and priorities, and also by reduced or con- strained budgets. These anti-collaborative behaviors are demonstrated in the recent rash of lunar flights, which have seen five different spacecraft sent to the moon by the USA, ESA, China, Japan and India; each mission essentially performing the same basic science missions. Expenditures for these repetitive efforts totaled between $2 and 3 billion dollars. More astounding, scientific data from several of the missions have not been shared. Were these just expensive stunts or merely lost opportunities? Perhaps better science and exploration could have been achieved if these activities had been consolidated into a single mission, with the excess funds spent on other scientific objectives. Now it seems the South Koreans, Brazilians, Iranians, and others want to launch their own Moon missions; their rationale draped in the words of great tribal patriots and accompanied by the best expressions of national pride.

J. Walter Faulconer, Strategic Space Solutions, 2010
[Space Policy, volume 26, pp. 143-151]
Eight different countries continue to subsidize their own launch capability and other nations are developing their own launchers. The USA prohibits US civil and commercial spacecraft from launching on Chinese vehicles. ESA demands that European satellites be launched on Ariane. These directions are driven by important national or regional interests. However, there may be no easy way to foster improved international cooperation if such protectionist behaviors stand in the way. And there are further obstacles to cooperation.

<u>COOPERATION KEY</u>

J. Walter Faulconer, Strategic Space Solutions, 2010
[Space Policy, volume 26, pp. 143-151]
Exceptionalism involves the perspective that a country or society is unusual or extraordinary in some way. Many nations throughout history have made claims of exceptionality: the USA, China, India, Britain, Japan, Iran (Persia), Korea (both South and North), Israel, the USSR, France and Germany. The term “exceptionalism” can also be used to describe a nation’s desire to remain separate from others. There is often a strong and intense political and cultural pressure to go it alone, to demonstrate a nation’s prowess and strength to show that a nation has joined the leaders of the world. This may explain South Korean plans to launch a lunar probe in 2020 and make a Moon landing by 2025, using a rocket the country is developing at a cost of 3.6 trillion won ($3.9 billion). The South Koreans, aware that their rivals and historical enemies, China and Japan, are both ahead of them in this field, are working hard to achieve success with their space programs; indeed, their space community leaders have told the authors that they take great pride in the successes they have already gained, and hope to gain. Exceptionalism also explains a desire by China for a national manned spaceflight, space station, and Moon programs; the desire by a wide variety of nations to develop spacelift and on-orbit capabilities; and, of course, the desire by other overachievers to launch missions to the moon.

J. Walter Faulconer, Strategic Space Solutions, 2010
[Space Policy, volume 26, pp. 143-151]
Unfortunately, exceptionalism pressures can cause inefficiency, with tremendous duplication and overlap in global space science and other missions. They can also generate considerable mistrust. For example, there has been much discussion about inviting China to participate in the ISS. Unfortunately, in its single-minded zeal to forge a unique world-class military and space program China has generated considerable mistrust among the international community. This is underscored by the program’s secrecy and the recent, alarming ASAT test that contaminated low-Earth orbit with thousands of pieces of space debris that will pose a threat to space systems for well over 100 years.

<u>COOPERATION KEY</u>

Joseph Imburgia, Lieutenant Colonel, US Air Force, 2011
[Vanderbilt Journal of Transnational Law, Volume 44, pp. 589-641]
Consequently, to better preserve and protect the national security interests of the United States by assuring access to space and the freedom to operate there, the United States must pursue a binding international agreement with real consequences, and it must persuade the international community to follow its lead.

Joseph Imburgia, Lieutenant Colonel, US Air Force, 2011
[Vanderbilt Journal of Transnational Law, Volume 44, pp. 589-641]
From 2004 to 2010, the annual growth rate of tracked debris increased every year except 2008. At the beginning of 2010, Earth's orbit held 2,347 more space debris objects measuring more than ten centimeters in size than it held at the beginning of 2009, a 15.6 percent increase. The greatest annual increase in space debris to date occurred in 2007. At the beginning of 2008, Earth's orbit held 2,507 more space debris objects measuring more than ten centimeters than it held at the start of 2007. This marked a 20.12 percent increase in the space debris population in just one year. A large portion of this increase is attributable to China and Russia, as discussed in the following subparts.

Joseph Imburgia, Lieutenant Colonel, US Air Force, 2011
[Vanderbilt Journal of Transnational Law, Volume 44, pp. 589-641]
To rectify this problem from a legal standpoint, and to immediately counter the national security threat that space debris presents, there must be a fundamental shift in how the United States and the international community perceive space debris. Rather than thinking about space debris in terms of its overall increase to the amount of man-made material in space, we must look at space debris in terms of the considerable risk that it poses to national security. Toward that end, the international community needs aggressive space debris removal and reduction efforts on a global scale, and it can effectuate the necessary change through international law. Without a collective international legal effort to induce a reduction in space debris, it will only be a matter of time before the free use of space is severely imperiled, if not forever lost.

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The devastating consequences described in the previous Part could be avoided through the implementation of a binding international agreement on space debris. Such an agreement must require, among other things, that countries make efforts to rid the space environment of the debris that they produce. The agreement must also require countries to create cost-effective methods to solve the current space debris problem, rather than simply mitigating future additions to the problem. To explain the necessity of such an agreement, however, it is important to first discuss why current international law on this issue is insufficient to address the monumental space debris predicament. Simply put, "there is no legal concept of 'space debris' under international space law and thus no mechanisms to regulate it.

Joseph Imburgia, Lieutenant Colonel, US Air Force, 2011
[Vanderbilt Journal of Transnational Law, Volume 44, pp. 589-641]
Because removal of debris is the only long- term solution, implementing a binding international treaty on this issue can only assist in drawing attention to the need for cost- effective debris-removal techniques. Legal necessity can sometimes be the mother of invention.

J.-C. Liou, NASA Johnson Space Center, 2011
[Advances in Space Research, volume 47, p. 1876]
As the beneficiary of the space age and related technologies for half a century, it is our responsibility to preserve the near-Earth environment for future generations. Analogous to efforts to fix other major environment problems, however, it will require major contributions, collaboration, and cooperation at national and international levels to move forward with ADR for debris environment remediation.

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Without legal consequences, including appropriate international sanctions for treaty violations, little international influence exists to compel space-faring nations to find a viable solution to this problem. Moreover, space debris threatens the durability and survivability of the space assets on which the United States so heavily depends for its national security. It is therefore in the United States' best interest to support a binding international agreement to deal with the removal and mitigation of space debris.